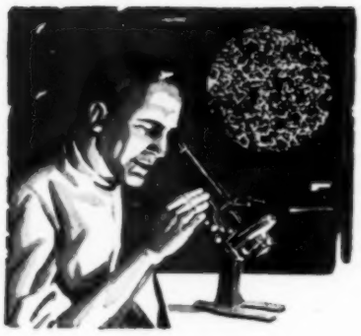


THE FOUNDRY

for June

Charts New AMBITION

WHEN Professor Robert E. Rogers advised each man of an eastern college graduating class to marry a studious girl with a government position, apparently he was not lacking in preception. A recent report of the National Industrial Conference board shows that the per capita average of wages and salaries of active employes in federal, state and local governmental positions was $1448 in 1932. This figure is 24.3 per cent more than the per capita full time rate for employes in all other fields of employment. From 1929 to 1932, the per capita average of wages and salaries of employes in the government group decreased only 1.2 per cent, while the average compensation of employes in all other fields of employment dropped 21.1 per cent. Soft indeed is a government berth when the winds of misfortune blow. But there are compensating burdens. Political upsets, the pressure of meddlesome constituents upon elected office holders and passed along to appointees all make for poignant grief. This might be passed along by the job-holding wives even to the professor's ex-students in the form of curtain lectures. Would it not be best after all, to advise these young men to seek the governmental sinecures for themselves, if they fail to find sufficient attraction in commerce, transportation, industry—or the foundry business.

No Time to RELAX

SIGNIFICANT reactions from industry measure the high standard of accomplishment along manufacturing lines in the foundry industry. Technical advances in the past ten years provide engineers and users today with castings qualities far ahead of those previously available. Metallurgy has given better metals and alloys. Now melting methods and heat treatment have added the highest attainments to physical properties. Molding, coremaking and all foundry manufacturing methods have kept pace. Assisted by intelligent design and application, castings find use and give service in fields entirely new, and they have regained others temporarily usurped by welded, forged and stamped products. This is testified even by those identified with the production of competing materials and structures. Already much concern is expressed by competing interests where castings are winning and holding new ground.

There must be no lapse. With the attention and time of management so occupied with the vital problems of sustaining their corporate existence, and the added complications injected by NRA, it is difficult to retain foundrymen's interest in technical advance. Nevertheless, this interest must be not only retained but intensified. The American Foundrymen's association representing all branches of the foundry industry already has performed stupendous service in furthering foundry practice and technique. Its responsibilities are enlarged under present conditions and its ability to serve the interests of all foundry groups in technical matters is a prime concern of those who compose its membership and official staff.

Speed and COMFORT

MUCH has been published recently in magazines and newspapers regarding new high speed, streamline trains which have been constructed and given trial runs, or now are being considered. Many writers predict a movement toward the new design is well under way. Recent tests on the trains indicate problems which may delay materially so radical a change in railroad passenger train construction. In a test run from Ft. Wayne, Ind. to Chicago and again from Denver to Chicago, railroad men considered it absolutely necessary to station section men at every grade crossing to guard the tracks for the train speeding better than 100 miles an hour. Until grade crossings are eliminated, it will be practically impossible to operate at such high speeds safely. Perhaps comfort, coupled with speed will mark the coming trend in the design of passenger trains. In this, weight will govern stability and the foundry industry should have considerable interest and much to offer.

Fig. 1—The spindle served as a guide in locating the inner ends of the cores

Steel Castings for Boulder Dam

High degree of foundry skill and technique involved in production of unusual castings

By PAT DWYER

WHAT is claimed to be the greatest industrial undertaking of the United States government since the Atlantic and Pacific oceans were linked by the Panama canal, rapidly is nearing completion in the Black Canyon of the Colorado about 25 miles south east from Las Vegas, Nev. At this point the erratic river makes a definite left hand turn and flows almost due south to its ultimate destination in the Gulf of California. A short distance below the turn, after a wild and tortuous flight of nearly 1000 miles through a slash in the earth's surface, in places torn away to a depth of thousands of feet in the solid rock, the dark red, turbid, turbulent waters of this great western river "too thick to drink and too thin to plow" are being subdued and harnessed by a solid concrete structure known as Boulder dam.

Far in the mountains to the north and east the river has its origin in two main branches, the Green river which rises in the Wind River mountains of western Wyoming, and the Grand river which rises in the Rocky mountains west of Denver. Before their junction at approximately 38 degrees N., and 110 degrees W., in Utah, the Green river is reinforced by the White, the Bear, the Uintah and the San Raphael. Tributaries of the Grand include the South Fork or Gunnison, San Miguel and Dolores. Below the junction the Colorado absorbs the waters from the San Juan, Dirty Devil, Escalante, Colorado Chiquito or Little Colorado and from the western or Nevada side the Paria, Tapeat's river, Kanat and Virgen. At flood periods when the snow is melting on the mountains, a volume of silt laden foaming water estimated at 300,000 cubic feet per second rushes through the lower gorges which separate Arizona from Nevada.

Magnitude of the undertaking designed to hold this formidable riotous and reckless giant in check may be inferred to some extent from the fact that in addition to an elaborate installation of mechanical equipment representing the effort and activities of a small army of skilled mechanics in various industrial centers, the services of 4000 men will be required on the job for six years. Preliminary work included boring two 50-foot diameter tunnels in the rocky walls of the canyon on either side of the river through which the water might be diverted while erection of the dam is in progress.

So far as human skill and knowledge can determine, nothing short of a general upheaval of the earth's surface in the vicinity will loose the dam from its anchorage. With foundations extending 150 feet into the solid rock at the bottom of the river and with the ends of the walls anchored solidly in mortises in the walls of the canyon on either side, the dam will form an integral and immovable part of the canyon itself. The dam will be 750 feet high, 650 feet wide at the base and 45 feet wide at the top where it will be 1180 feet in length.

Water Would Cover Three States

Any person curious for further statistics will be interested to learn that this mighty barrier will contain 3,500,000 cubic yards of concrete; that the resulting lake will extend 115 miles upstream and in places will be 8 miles wide; that this lake will contain 30,500,000 acre feet of water, sufficient—if such a feat was possible—to cover the entire states of Maine, New Hampshire and Vermont with water to a depth of 1 foot; that this capacity is equal to the anticipated volume of water carried down by the river over a two-year period; that a deposit of 100,000 acre feet of silt is anticipated over every 12-month period; and that finally this accumulated silt deposit—if undisturbed—will completely fill the space behind the dam in exactly 22? years.

Boulder dam was designed primarily as part of a general reclamation system in which the object is to control and manipulate any given source of water supply for irrigation purposes. Instead of submitting to alternate periods of flood and drouth, the flood waters are impounded and held in storage to be released in regulated volume throughout the year including the normally drouthy periods. Incidentally the lake will serve as a settling basin for the removal of silt from the water before it enters the irrigation canals, or is used for any other purpose.

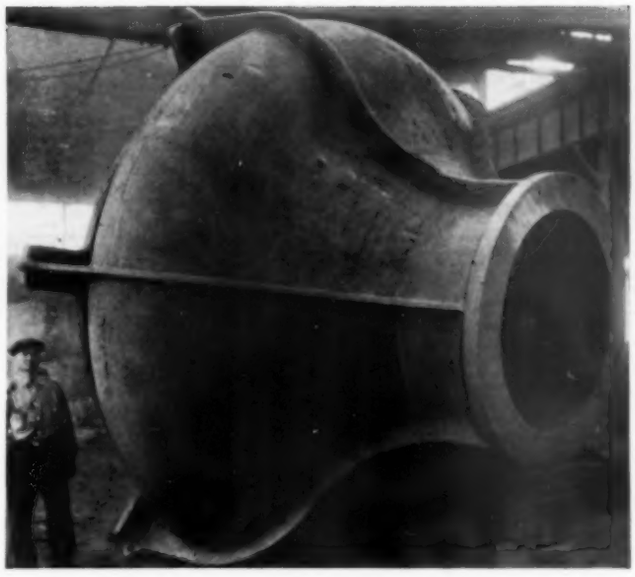


Fig. 3—Outside view of energy absorber casting showing location of ribs, feet and flanges

In addition to its value as an irrigating medium the dam will serve as a source of hydroelectric power for a large area of the Southwest. Before the electric current generated at Boulder dam can reach centers of population in southern California, it has to be carried 230 miles through a great waste country to a crossing of the San Bernardino mountains near Cajon pass, gateway from the desert to the vast garden country to the west.

The city of Los Angeles will take 15 per cent of the total anticipated 1,850,000 horsepower to be developed. This output may be compared

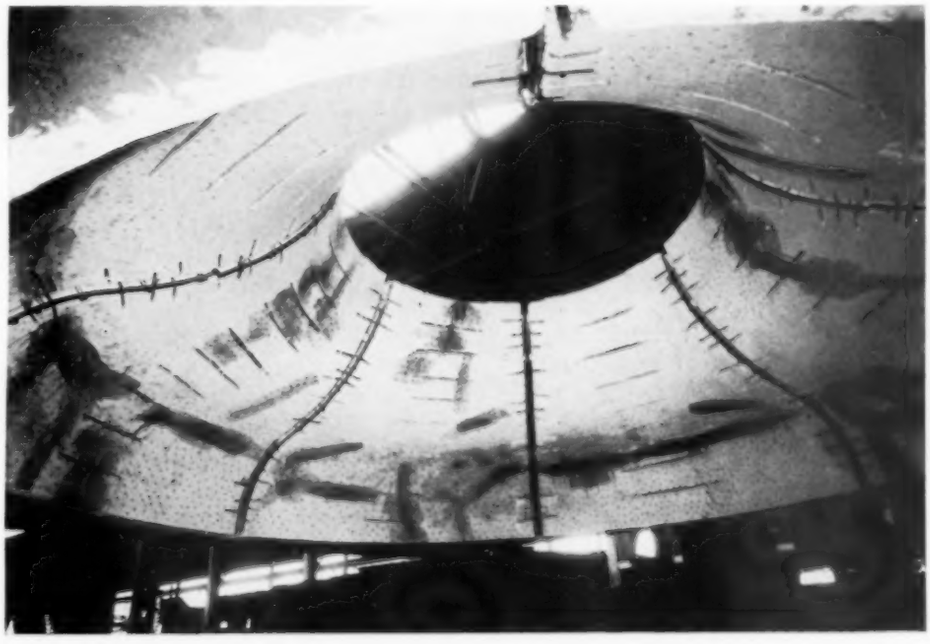


Fig. 2—View looking up into the lower cheek from the floor level

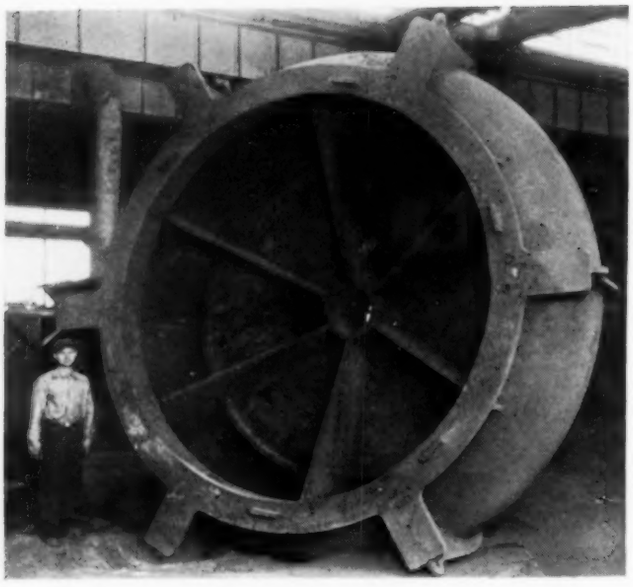


Fig. 4—End view of energy absorber casting showing inner cone diaphragm and reinforcing ribs

with the 453,500 horsepower developed on the American side of Niagara Falls, and the 600,000 horsepower capacity of the Muscle Shoals dam on the Tennessee.

Contracts for equipment and machinery required in the operation of the dam and power plant have been placed with several manufacturing interests. The large steel castings shown in the accompanying illustrations were made at the plant of the Machined Steel Casting Co., Alliance, O., and form part of the mechanism which controls the flow of water after leaving the turbines. A hydraulically operated piston works inside the three-way globe valve, Fig. 7, which in turn is mounted on the energy absorber, Figs. 3 and 4. The solid column of water falls on the cone diaphragm which absorbs the shock and discharges the water in a comparatively thin stream around the lower perimeter.

Steel for the castings was melted in one of a pair of 25-ton acid lined, oil fired open-hearth furnaces located at one end of the foundry building. For the energy absorber casting with a total weight including gates and risers of nearly 70,000 pounds this meant an over load of 40 per cent or almost double the normal capacity of the furnace. The metal was plain carbon steel showing a tensile strength of 70,000 pounds, carbon 0.28 per cent and manganese somewhat higher than usual, 0.80 per cent. A bend test piece from this steel readily is bent completely around a 1-inch pin without any sign of surface fracture. The castings are subjected to 500 pounds per square inch water pressure test.

The high, spacious and well lighted foundry building 100 x 600 feet is equipped with all modern conveniences for handling a wide variety of miscellaneous castings. Sand preparation department, core room, core and mold drying ovens occupy a side bay. The furnaces occupy a space at one end of the main bay and the castings are cleaned at the other end. The remainder of the floor space is devoted to molding and pouring the castings. New sand is stored in bins beyond the furnaces and is fed by gravity to a belt in a tunnel which conveys it to the mixers. An automatic scale accurately weighs the amount of sand in all core and facing sand mixtures. A batch of dry sand facing contains 400 pounds new sand, 500 pounds old sand, 2 shovels of silica flour and 3 shovels clay. A batch of sand for the cores contain 500 pounds new sand, 400 pounds old sand, 8 quarts proprietary dry binder and 2 shovels clay.

Flasks Built Up in Sections

A large stock of heavy cast steel flask parts is available in several standard lengths and widths. Combinations of these parts are assembled to suit the requirements of any given mold. On account of the great weight involved in some instances the mold is made up with one or two extra sections in addition to the usual cope and drag. For example, on the casting shown in Figs. 3 and 4 and weighing 57,000 pounds the mold was made up of a drag, two cheeks and a cope. The inside part of the mold shown partly assembled in Fig. 1 was made up of 41 cores.

With the drag in place on the rollover board, the bottom section of the pattern was centered in place and covered with facing sand. A sand slinging machine made by Beardsley & Piper Co., Chicago, was utilized to fill the remainder of the drag with backing sand and ram it to the required density. A sectional bottom plate was

Fig. 5—Cores from the ovens are unloaded in this side bay

clamped in place and the entire assembly rolled over and leveled on the floor. The upper part of the pattern was adjusted in place and surrounded by the first or lower cheek. This part of the flask and the upper or supplementary cheek were provided with transverse bars to support the weight of the sand. The face of the pattern between the six vertical ribs was gaggered in the usual manner and the sand slinging machine was employed to fill and ram the sand. The assembly was surmounted by a plain, flat cope containing the openings for the feeding heads on the upper flange of the casting.

Gated at Several Levels

A 3-inch diameter sprue extended from the top of the cope near one corner to the bottom of the mold where gates were formed to conduct the metal into the mold cavity. A second gate was cut in the drag joint as shown at *A* Fig. 1 and a third gate in the joint between the upper cheek and the cope carried hot metal into the top flange. All the metal was poured from a single bottom pour ladle.

The four parts of the mold, drag, two cheeks and cope were separated, finished, surface nailed, coated with silica wash and dried in the large ovens provided for this purpose. Afterward the drag was lifted from the car and lowered into a large concrete pit in the floor for the reception of the core sections designed to form the inner part of the casting. Later the cheeks and cope were lowered into place and the mold made ready for the metal without any further change in position.

To facilitate handling, the core was divided on 12 radial lines, corresponding to the six vertical ribs on the inside, and to six similar ribs on the outside, but located midway between the areas occupied by the ribs on the inside. This

Fig. 6—Cores were provided with lifting hooks and heavily reinforced with rods and short pieces of pipe

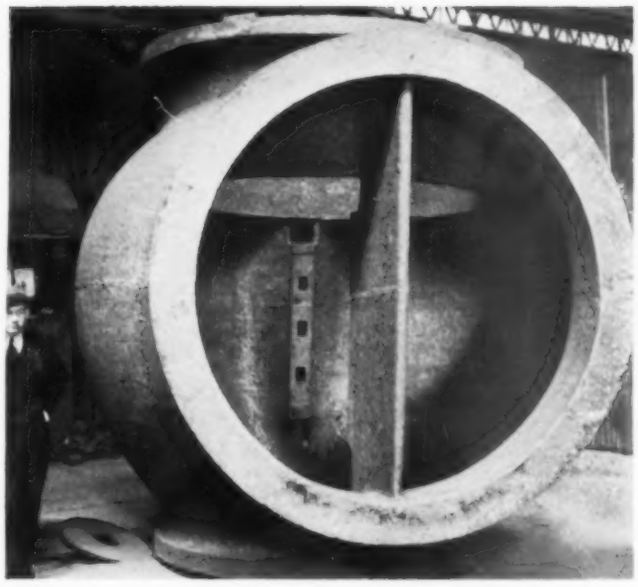


Fig. 7—Relief valve casting molded and poured in the position shown

distribution of the ribs equalized the metal thickness in the casting to a greater extent than if the outside and inside ribs were in the same plane.

Long steel rods, ¾-inch diameter and bent to the required contour were anchored by nails in the space represented by the junction of the ribs with the casting. This feature is shown in greater detail in Fig. 2, a view looking up into the lower cheek where it rested upon supports before the mold was closed. A large number of thin brackets or fins cut in the cheek and also in the cores in the vicinity of the vertical ribs prevented the casting from pulling or tearing during the contraction period. After the casting was cleaned these fins were cut away with a torch.

Spindle Served as Center

With the drag leveled on the bottom of the pit, the center core *E* was plumbed in position and surmounted by a short steel spindle. The cheek then was lowered into place temporarily so that the spindle might be truly centered by measurement from the top flange of the mold in the cheek. The cheek then was removed and placed back on the stands. In this manner the spindle served as a guide in adjusting the inner ends of the cores to secure a uniform thickness of metal in the wall of the casting. Wood thickness strips placed against the outer wall of the mold in the drag regulated the position of the outer ends of the cores.

The first core of the series *B* Fig. 1 was lowered into the drag so that the rib face at the left coincided with a diagonal center line on the lower drag face, thus locating this rib in position below and midway between two of the radial ribs in the cheek. With the first core in place and occupying a certain definite position in the drag, the remainder of the series automatically dropped into their (*Please turn to page* 42)

Exhibit Stimulates Early Interest

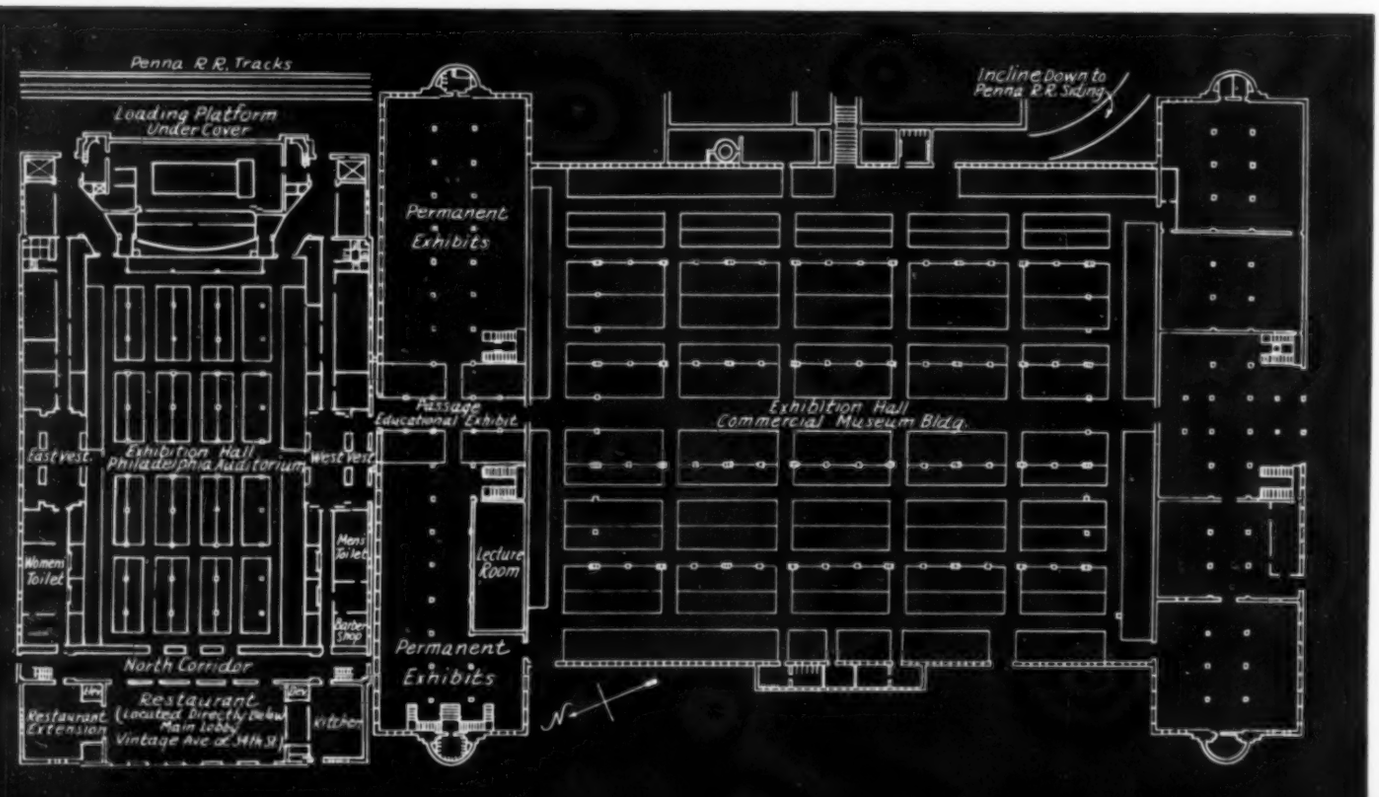
Manufacturers of equipment and supplies look forward to imposing show in Philadelphia

INTEREST thus far displayed in the exhibition of equipment and supplies, which will be held in Philadelphia, Oct. 22-26 in conjunction with the fifth International Foundry congress and the 38th annual convention of the American Foundrymen's association, indicates a show which will compare favorably in size and attendance with the exhibitions in Detroit in 1926, Philadelphia in 1928 and Cleveland in 1930. Many factors are influencing favorably the rapid development of an exceedingly successful convention and show, including the time, place and the international character of the meeting.

A major part of the foundry industry experienced an exceedingly gratifying improvement in business in the first half of 1934, and during that period, considerable foundry equipment has been purchased. The fall season will see a further improvement in most phases of business activity, according to many economists, and this increased output will be reflected in an urgent need for new foundry equipment. The need for machines to provide economies in the production castings and to replace equipment either worn out or obsolete, is being satisfied to an increasing extent as industry moves along the road to recovery, and many foundrymen will be at Philadelphia to see the latest developments.

The last foundry exhibition to be held in the East was staged in Philadelphia in 1928. Since that time, conventions have been provided in Cleveland, Detroit and Chicago. This is the longest period in history that the association has not had a technical convention and an exhibition along the Atlantic states, and therefore this year should find the great majority of foundrymen in that section of the country ready and in fact anxious to attend. Undoubtedly the traveling urge again is abroad in the United States, as witnessed by the millions attending the Fair in Chicago a year ago, so that a normal or better attendance may be expected from the remaining parts of the country.

Visitors at the Detroit convention in 1926 will remember the International touch provided by the presence of a large party of European foundrymen. Many of these (*Please turn to page* 42)



Steel Founders Laud NRA Effects

Report progress in applying code to employment and merchandizing problems

OPERATING under the first of the foundry division codes to be approved, the steel foundry industry has had more than six months experience with NRA. In a report compiled by Col. Merrill G. Baker and recently transmitted to the administration, satisfaction is reported with the results accomplished and the effect upon earnings of labor and on commercial practices is analyzed.

A statistical study of the character and capacity of foundries, Table I shows that the industry is mainly composed of small units. Further, of the total monthly rated capacity, 109,733 net tons, more than half or 57,968 tons is embraced by 20 foundries making railway specialties.

The benefits accruing to labor under the code, as presented in the report, show that in this industry, which normally would employ 50,000 men the average number working has been increased 32 per cent between July, 1933 and March 1934. The average hours of work per employe, in this period has decreased 19.5 per cent and the average hourly earnings have advanced 14.8 per cent.

Since the report was compiled an additional 10 per cent advance in wage rates has been applied by more than 90 per cent of the industry. The figures are significant, in that more than 50 per cent of the cost of producing steel castings is found in the labor item.

Steel casting prices have been ruinously low for a number of years. Competitive price cutting, coupled with the superior organization and purchasing talent of customers have produced a state of chaos. One feature of pricing which has been exceedingly damaging is the practice followed for many years of selling on schedules, without any definite and recognized classification under these schedules. One member of the industry might apply a (*Please turn to page* 44)

Table I

Steel Foundries in the United States

Arranged According to Size

Size of Foundry—Rated Capacity Net Tons per Month	Number of Foundries	Total Capacity of Group	Average Monthly Capacity of Group	Per cent of Total Number	Per cent of Total Capacity
1 to 100	54	2,421	45	30	2
101 to 250	41	6,988	170	23	6
251 to 500	34	12,511	368	19	12
501 to 1000	25	16,795	672	14	16
1001 to 2500	15	23,267	1,551	8	21
2501 to 5000	5	18,053	3,611	3	16
Over 5000	5	29,698	5,940	3	27
	179	109,733	613	100	100

Table II

Some Statistics—Steel Casting Industry—

July, 1933 to March, 1834

(Miscellaneous Castings Only)

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Per cent Increase July '33-March '34
Number of Foundries Reporting	119	113	113	114	171	177	181	182	176	
Production in per cent of Capacity	25.2	27.7	25.2	24.9	25.5	25.4	27.4	29.6	36.8	46.0
Average Selling Price Per Ton	$137	$144	$144	$149	$144	$146	$154	$154	$151	10.2

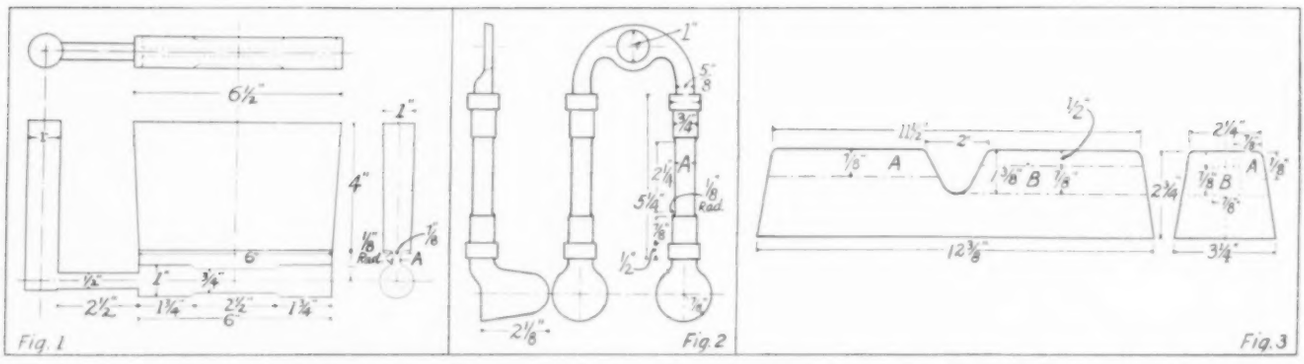


Fig. 1—Sand cast test bar designated as the fin-gate type. Fig. 2—Sand cast test bar designated as the end-gate type. Fig. 3—Position of test bars in the chill ca st ingot, A, two side chill; B, no side chill

Studies Cast Red Brass

Casting data collected to establish basic classification of nonferrous ingot metals

By C. M. SAEGER JR.
Bureau of Standards, Washington

A SPECIAL committee on promotion of general use of specifications for copper alloys in ingot form was organized by the American Society for Testing Materials in 1929. This committee, consisting of representatives of producers and consumers of copper base ingot metals, had for its purpose the study and promulgation of the use of specifications for copper alloys in ingot form and to recommend to the society such revisions in American Society for Testing Materials specifications affected by these studies indicating the desirability towards reducing the number of specific nonferrous ingot metal alloys which at present in commercial use.

Producers of nonferrous ingot metals organized an institute, known as the Non-Ferrous Ingot Metal institute. Through the co-operative efforts of the members of that institute with the American Society for Testing Materials and other technical bodies, definite progress has been made toward the standardization of the nonferrous alloys in use. As a result of a survey made, it was found that over 600 so-called common alloys were in use, and in addition many special alloys usually are classed as high strength alloys. Tentative specifications have been promulgated and approved by the American Society for Testing Materials covering 20 nonfer-

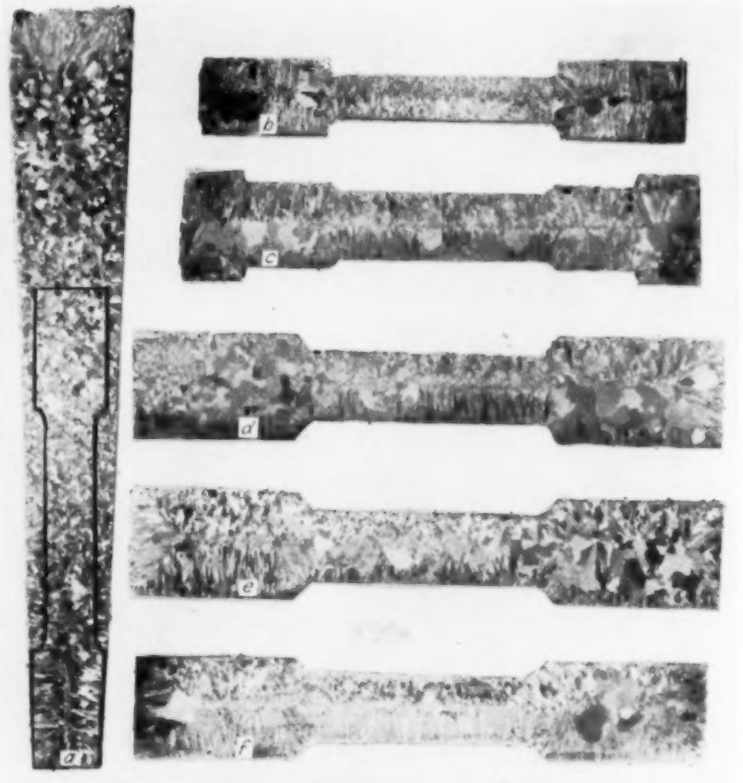


Fig. 4—Medial longitudinal section of test bars of virgin metal, cast at 1205 degrees Cent., the section being perpendicular to the parting face of the sand mold, etched with ammoniacal solution of copper-ammonium chloride. Reduced one-half

rous alloys. It is believed that these, to a very large degree, may be used in place of the more than 600 now in use. Steps along educational lines will be necessary to make the work useful and effective. Of course it is not believed that the industry will in 5 or 10 years from now be producing only 20 nonferrous alloys, but at least a goal has been set and constructive efforts should be made to approach it as closely as possible. It has been found that there are 40 different specifications for one of the most widely used alloys of the industry, namely, 85 per cent copper, 5 per cent tin, 5 per cent lead, 5 per cent zinc. The variation between specifications in all cases is slight, either in allowed tolerances of the main constituents or in the impurity content, namely, nickel, sulphur, phosphorus, iron, antimony, etc. It appeared in this case that these 40 specifications could probably be replaced by one.

The Non-Ferrous Ingot Metal institute has been instrumental in bringing about co-operative arrangements with the bureau of standards, whereby technical research now is being conducted at that bureau for the purpose of providing additional and better information regarding copper base casting alloys than is at present available.

The co-operative investigation is conducted at the bureau of standards by H. B. Gardner, a research associate for the Non-Ferrous Ingot Metal institute, under joint direction of the bureau and an advisory committee, appointed by the institute, consisting of Dr. G. H. Clamer, president, Ajax Metal Co., Philadelphia, F. L. Wolf, chief engineer and technical superintendent, Ohio Brass Co., Mansfield, O., and J. W. Bolton, metallurgist, Lunkenheimer Co., Cincinnati. That advisory committee has aided considerably, especially when the commercial aspects of the problem were involved. This article shows a type of research conducted at the bureau of standards in co-operation with industry to bring about simplification of standard specifications.

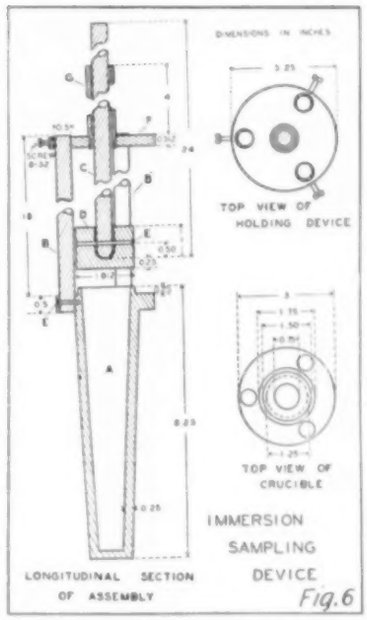


Fig. 6—Device for obtaining test bars by the immersed crucible method

In the tentative program, red brass of the nominal composition, 85 per cent copper and 5 per cent each of zinc, tin and lead, which is one of the most widely used commercial alloys, was selected as the first alloy to be studied. The important variables include the form of the test bars, the method of casting them, the pouring temperatures, any possible differences between virgin metal and remelted metal, and the effects of definite amounts of known impurities. The effects of these factors are summarized.

Pouring temperatures of 1900 degrees Fahr. (1040 degrees Cent.), 2000 degrees Fahr. (1095 degrees Cent.), 2100 degrees Fahr. (1150 degrees Cent.), 2200 degrees Fahr. (1205 degrees Cent.), and 2300 degrees Fahr. (1260 degrees Cent.) were used in the study of virgin metal, remelted metal and the effect of sulphur. For the effect of iron, pouring temperatures of 1950 degrees Fahr. (1065 degrees Cent.), 2100 degrees Fahr. (1150 degrees Cent.) and 2250 degrees Fahr. (1230 degrees Cent.) were used. The following properties were determind in sequence on each bar: Electrical resistivity, tensile properties, density and brinell hardness. In addition, the shrinkage from above the maximum pouring temperature to room temperature, and the running properties at each of the pouring temperatures were determined. Metallo-

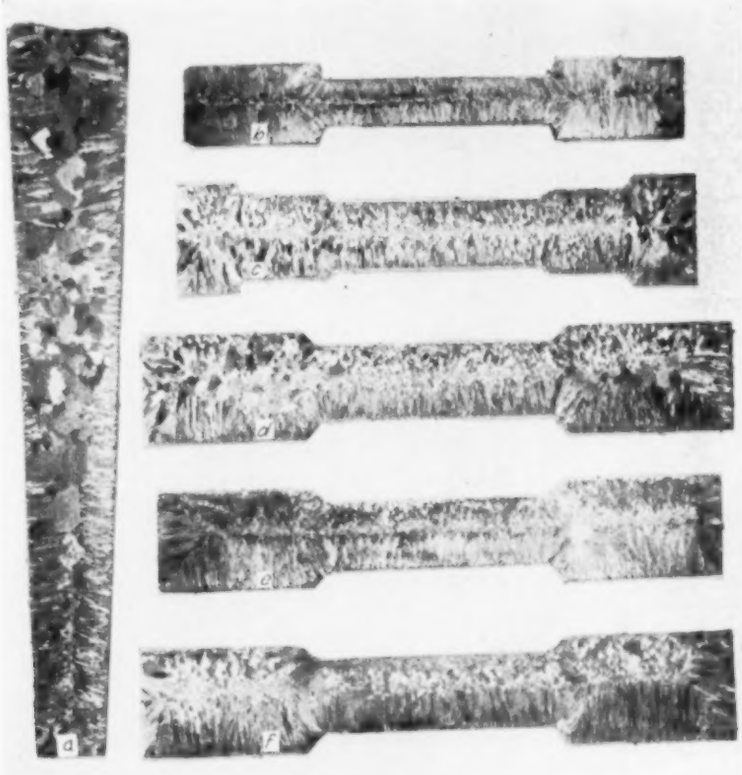


Fig. 5—Medial longitudinal section of test bars of virgin metal, cast at 1260 degrees Cent., the section being perpendicular to the parting face of the sand mold, etched with ammoniacal solution of copper-ammonium chloride. Reduced one-half

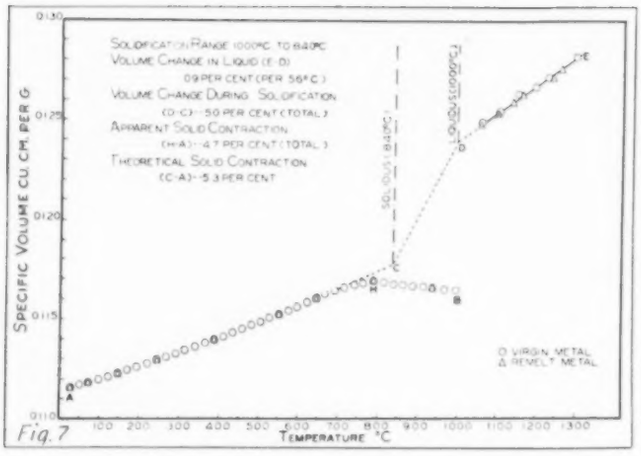


Fig. 7—Shrinkage of red brass from 1315 degrees Cent. to room temperature

graphic examination of the structures were also made.

When the virgin metals used for making the alloy were analyzed chemically, the only impurities found that might have any real significance were: 0.0052 per cent iron in the copper; 0.01 per cent iron in the zinc; 0.016 per cent iron and 0.12 per cent bismuth in the lead; and 0.023 per cent iron in the tin. The alloys were made up in heats varying from 80 to 100 pounds, and each constituent metal was weighed to within one per cent. The term *remelted metal* is used throughout the paper to refer to the 85-5-5-5 alloy which was made from virgin metals, cast into ingot form, remelted and recast into test bar molds. The extreme range of composition as determined by analysis of the various heats was as follows, although in most of the heats the variations were much smaller. The slightly larger variation in zinc content, especially in the remelted metal, was caused by the greater volatility of the zinc:

Metal	Copper Per Cent	Tin Per Cent	Lead Per Cent	Zinc (by difference) Per Cent
Virgin	84.52-85.56	4.91-5.26	4.80-5.28	4.64-5.21
Remelted..	84.45-86.06	4.91-5.23	4.77-5.25	4.50-5.42

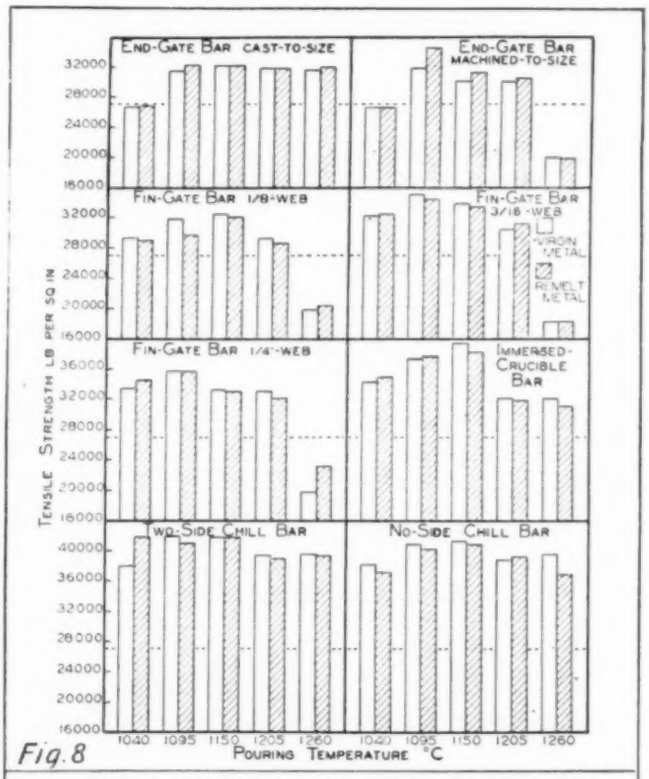
Stick sulphur, and a copper-iron *hardener* which contained 52 per cent of iron and was prepared from virgin copper and commercial open-hearth ingot iron, were used in preparing alloys containing sulphur and iron, respectively.

Molded in Green Sand

Green-sand molds were prepared from grade 00 Albany sand. A permeability number of 12 to 16 (American Foundrymen's association units), a compressive strength of 5 to 7 pounds per square inch and a moisture content of 6 to 6.5 per cent were maintained throughout in preparing the sand for the molds.

The metal was melted in a high-frequency induction furnace of the lift-coil type in a double-wall clay-graphite crucible. Each melt was heated to a temperature 56 degrees Cent. higher than the temperature at which it was to be poured. A double-wall crucible was used to minimize the drop in temperature during the pouring. The greatest difference in pouring temperature between the first and last of a series of test bars from one heat poured at 1040 degrees Cent. was 5 degrees and was approximately twice as great at 1260 degrees Cent.

The sulphur additions were made by placing the necessary amount of stick sulphur, as determined by analysis of preliminary melts, in a perforated graphite container which was sub-



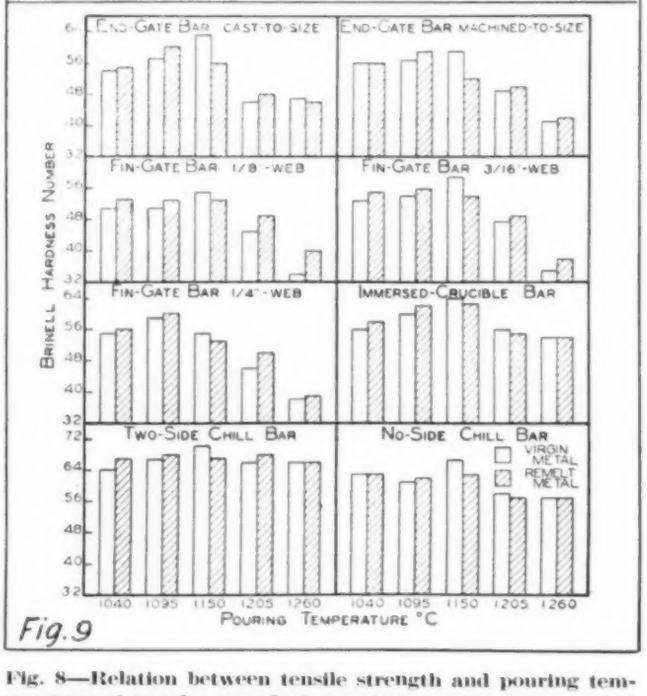
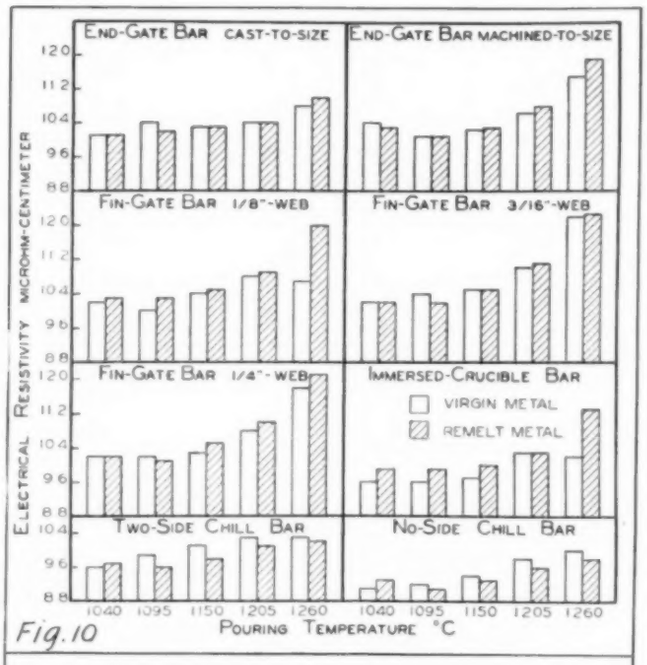


Fig. 8—Relation between tensile strength and pouring temperature of test bars made from virgin metal and remelted metal. Fig. 9—Relation between brinell hardness and pouring temperature

merged in the molten metal until all agitation resulting from the reaction of the sulphur with the metal had ceased. In making an addition of iron, the copper-iron hardener was added just before the charge was melted completely. Subsequent analysis of the alloys showed that in every case the content of sulphur or iron was within 0.05 per cent of that desired.

Two forms of sand-cast bars, a chilled ingot, and ingots obtained by immersing a graphite crucible beneath the surface of the molten metal were made from each heat.



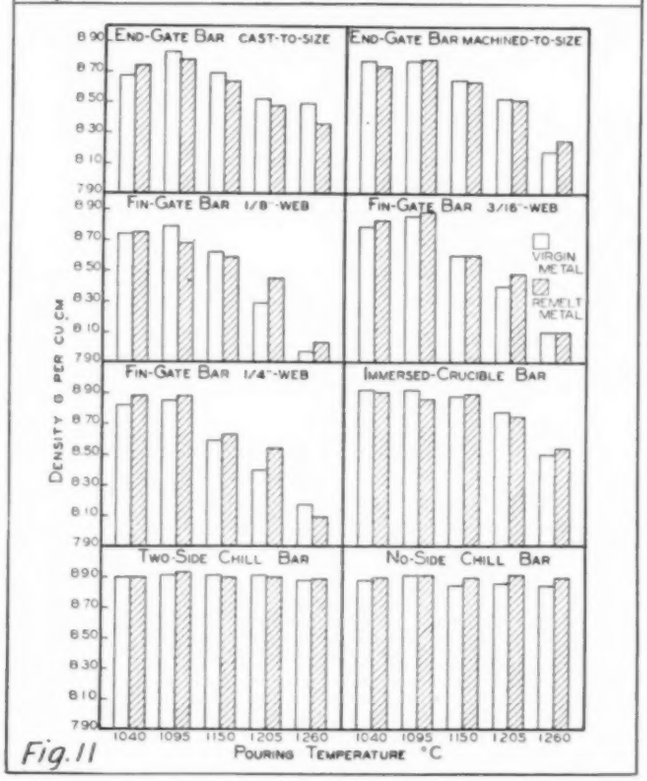


Fig. 10—Relation between electrical resistivity and pouring temperature of test bars made from virgin metal and remelted metal. Fig. 11—Relation between density and pouring temperature

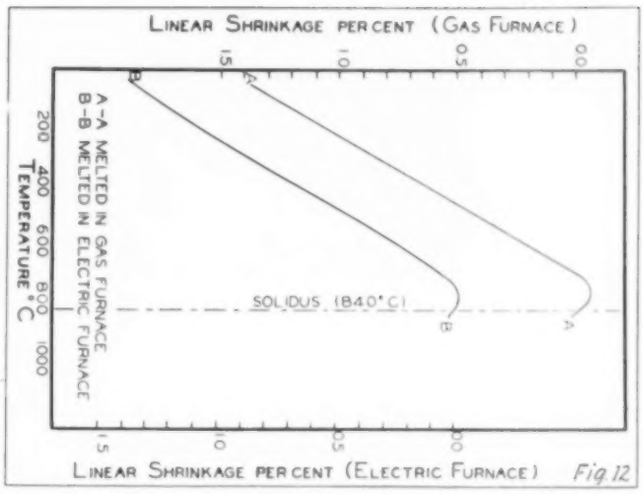


Fig. 12—Linear contraction of red brass from solidification to room temperature

Fin-gate sand-cast bar—This type of test bar, often designated as the Webbert bar, is shown in Fig. 1. The thickness of the web *A* was varied as follows: ⅛, 3/16 and ¼-inch. Its use is required in the specifications of the American Society for Testing Materials for brass castings, standard specifications for composition brass of ounce metal sand castings (A. S. T. M. Designation B62-28), A. S. T. M. Standards, Part 1, Metals, page 678, 1930. Test specimens each having web thickness of ⅛, 3/16, or ¼-inch, respectively, were used in the study of virgin and remelted metal, while specimens having a web thickness of ¼-inch were used in the study of the effect of sulphur and iron.

Poured Under Identical Conditions

End-gate sand-cast bar—A characteristic feature of this type of casting, shown in Fig. 2, is the absence of the heavy riser which tends to retard the cooling of the test bar. In the cast to size bar $A = 0.505$ inch; in the machined-to-size bar, $A = 0.625$ inch. The casting is poured uphill at an angle of 7 degrees with 1-inch round pouring gate 5 inches high. This method furnished two bars poured under identical conditions which were used to study the *skin effect* by comparing the properties of bars cast to size with those machined to size. This type of bar has been used with pronounced success in commercial foundry work on nonferrous alloys, according to a paper by R. W. Parsons, entitled "Deep Etching of Brass Applied To Gating Problems." Transaction A. F. A., 1931.

Coupon from chill-cast ingot—Two specimens were cut from each chill cast ingot as shown in Fig. 3. One specimen was taken from that portion of the ingot which included two adjacent chill faces and the other from the portion farthest removed from the chill faces. These have been designated as *two-side chill and no-side chill*, respectively. (*Please turn to page* 49)

Beautiful building in which the museum will be housed

Museum To Have Foundry Exhibit

Old Columbian Exposition building to house Rosenwald Museum of Science and Industry

By DAVID EVANS

Chicago Steel Foundry Co., Chicago

IN THINKING of a museum, one instinctively visualizes a storehouse of antiquities, endless glass cases of dead exhibits and miles upon miles of tiresome aisles. The Rosenwald Museum of Science and Industry in Chicago is anything but that. It is in fact an exhibit of moving, vibrant, living creations; depicting step by step every advance of our civilization from the very earliest times.

The museum is due in large part to the generosity of the late Julius Rosenwald, from whom it gets its name, and to the South Park board, which co-operated with Mr. Rosenwald in providing the building in which the museum is housed.

That building is the old Fine Arts building of the World's Columbian exposition, reproduced in enduring stone and preserving every fine architectural detail which makes it one of the fiest examples of classical architecture on this continent. It stands in the north end of Jackson park, facing the Hyde Park boulevard entrance. Its facade stretches across the park for a distance of over 1200 feet and yet is proportioned so perfectly that nothing of beauty or dignity is sacrificed for mere size. The visitor is advised to contemplate the building itself at a distance of several hundred feet before entering.

The primary purpose of the museum is educational. It will be a regular part of the public school curriculum. School children visiting the museum, in care of their teachers, will have the opportunity not only of seeing and studying every process of production having to do with the things used in our every day life, but by an arrangement of buttons and levers may themselves put the mechanisms into motion.

The museum staff operates a large model shop for the reproduction of working models of every sort of mechanical device, perfectly authentic in design. Many of the models date back to the most primitive age of our civilization when only the crudest hand implements were used. Down through the ages of horsepower, water and steam to electricity and gas. Paralleling these exhibits will be shown developments in chemistry and metallurgy as they have been moved hand in hand with the useful arts, until these later sciences have themselves become fundamental to our present mode of life. It is hard to imagine the mind, either of child or adult, that will not be stirred and inspired by a visit to such an exhibition.

Foundry Industry Prominently Displayed

The exhibit of the art of founding by no means will be a department of minor importance. This display will be located in the southwest wing of the building and, as planned, will occupy the South wall on the second floor. An advisory committee was formed under the auspices of the American Foundrymen's association several years ago to co-operate with the museum authorities. This committee represents every branch of the producing industry; Gray iron, malleable, steel, brass and aluminum, as well as the foundry equipment industry and foundry architecture.

The general outline of the foundry exhibit will show, as the skele- (*Please turn to page* 52)

Duplexing Malleable Cast Iron

Metal is melted in four cupolas and superheated in two electric furnaces

By CHARLES MORRISON

General Motors Corp., Saginaw, Mich.

PREVIOUS to the introduction of mass production, the usual method of manufacturing malleable castings utilized iron melted in an air furnace on open-hearth furnace. These furnaces were charged with pig iron and sprue and the melting required from 6 to 10 hours. During the melting period, molds were put up in floors arranged around the furnace for convenience in pouring off. When the iron was ready, molds were poured by hand, the pourers going to the furnace for each ladle of iron. After the iron was all out, furnace was recharged and melting started again. During melting period, the molds were shaken out, the sand cut, reconditioned and molds put up for the next heat. The average air furnace capacity was from 20 to 35 tons per heat. With good luck a furnace could turn out 50-65 tons in 12 hours. A large floor space was required and many flasks were necessary.

To Meet Intensive Production

With the growth of the automotive industry and mass production, large quantities of high grade malleable castings were needed. To meet the demand, either additional furnaces with tremendous floor space, huge flask equipment, etc. had to be provided, or an entirely new method of operation had to be devised, whereby the floor space could be used more advantageously, the flask equipment used oftener, and large melting capacities could be had from comparatively little equipment.

Designing of continuous molding and pouring conveyors and continuous sand handling and conditioning equipment made possible the production of large tonnages and rapid turnover of the flask equipment, but a continuous supply of uniform hot metal was necessary. To meet the needs of continuous pouring, duplexing was developed, which consists of melting in the cupola and superheating in an electric furnace; two furnaces being used so that one furnace is available for tapping at all times of the day.

In the installation which will be discussed, the metal is melted in 102-inch diameter cupolas. Four are provided, two being used at a time while the other two are being repaired. The cupolas are lined to 72 inches at the melting zone and each has a capacity of 28 tons per hour. Iron is melted continuously from the time the blast is put on until the bottom is dropped, with the exception of a short period during the changing of shifts. Each cupola has a 10-ton oval-shaped forehearth for the storage and mixing of iron. Slag is taken off at the rear by sluicing with water into a receiving tank from where it is elevated into a hopper by a bucket elevator. Trucks then remove it to the dump at regular intervals.

Molten Iron Picks Up Carbon

Charging is accomplished by hand. The charge weighs 10,000 pounds and consists of sprue, silvery pig iron, steel rails and pressed steel bundles. A coke ratio of about 9-1 exclusive of the bed is used between the charges, 320 pounds of limestone being placed on top of the coke. A bed 54 inches high and weighing 5000 pounds is used. The analysis of the charge going in is as follows: Carbon 1.70 per cent; silicon, 1.60 per cent; manganese, 0.60 per cent; phosphorous, 0.060 per cent; sulphur, 0.090 per cent.

The analysis of the iron at the cupola spout is as follows: Carbon, 2.70 per cent; silicon, 1.15 per cent; manganese, 0.40 per cent, phosphorous, 0.060 per cent, sulphur, 0.140 per cent. Fused soda ash is added to the metal at the spout to reduce the sulphur and refine the metal, four pounds per ton of iron being required to lower the sulphur to 0.110 per cent.

About 1.00 per cent of carbon is absorbed from the coke, this fact being of major importance in the control of the process. In computing the air-coke ratio for blast requirements due allowance must be made for this carbon or excess air will be blown and the iron will be oxidized excessively. The blast volume is regulated automatically by flow controllers which are set for the desired blast and in no case are the air requirements for the maximum rate of melt exceeded. This is a most important feature.

Iron at the cupola is about 2800 degrees Fahr. and will vary above and below that figure with certain kinds of coke. The cupola is tapped intermittently, the crucible holding about 4½ tons. Sprues poured from the forehearth iron have a black core or the presence of primary graphite, a considerable portion of the carbon being out of solution. Forehearths are skimmed frequently to insure against basic slag being carried to the electric furnaces. As a further precaution they have a teapot spout and are kept as full as possible throughout the day.

Two direct arc type electric furnaces are used for superheating the iron. Each furnace has a capacity of 4 tons cold melt and 32 tons duplexing. Each furnace is equipped with a transformer rated at 3000 kilovolt-amperes, with a 40 degree rise and 3450 kilovolt-amperes with a 50 degree rise. However, they are run about 5500 kilovolt-amperes over a 3 minute period. There are 85 volts and 16,000 amperes across the arc with 150 volts across the electrodes, the current being 60 cycle, 3 phase. Each furnace has three 12-inch diameter graphite electrodes, the movement of the electrodes being controlled automatically by current and voltage coils.

Sections of Furnace Water Cooled

Bottoms of these furnaces consist of 2 courses of clay brick with successive layers of ganister fused in to a thickness of 16-20 inches. Side walls consist of 13 inches of silica brick, there being ½-inch of silica sand between the side walls and shell. The top consists of silica brick formed on a template with a retaining ring, plugs being inserted at the electrode openings. The electrode cable holder, door arches, roof retaining ring, electrode glands and one-half of the side walls are water-cooled. There is a pouring spout at the front and a receiving spout at the rear of the furnace. Tilting is done electrically or by hand.

A bath of 10 tons is held in the furnace and is kept free of slag, as slag from the forehearths is basic, and destroys the acid lining. One furnace taps out while the other is heating, thus a continuous supply of hot metal is available at all times. When about 3 tons of metal has been taken from the electric furnace, additional metal is brought from the cupolas by a 3-ton hot metal crane. This iron is about 2700 degrees Fahr. Two hundred forty pounds of steel scrap is added to the furnace with each charge of cupola metal. The steel reduces the silicon 0.04 per cent and the carbon 0.08 per cent. However, the latter is picked up later from the electrodes. There is no appreciable change in the percentage of manganese, phosphorus or sulphur. The steel together with the superheating of the iron puts the carbon back into solution. With normal operation sprues poured from the electric furnace iron show clear as there is no primary graphite present.

Ferrosilicon and ferromanganese are added occasionally to the furnace during a charge of cupola metal but the addition of ferrosilicon is undesirable as it throws the carbon out of solution causing mottled iron (primary graphite). With the proper cupola control it is not necessary to add either. A rigid examination is made of the steel scrap to prevent contamination with nickel plating, aluminum and other deoxidizers which would cause the carbon to be thrown out of solution. Care also is taken to prevent chromium bearing metal or other carbide stabilizing elements from accidentally entering the iron.

The iron is heated over a 2 to 3-minute period. The input is held as low as possible and the heating period as long as possible. This is done for three reasons: First, a low current density is desirable to minimize the carbon pick-up, the density being held below 135 amperes per square inch of electrode; second, a low input is easier on the furnace refractory and third, this method of heating is most economical.

Insures Uniformity of Composition

Following the heating period the furnace is tapped out while the other furnace is receiving cupola iron, and heating. Ladles of iron from the cupolas are alternated in such a manner that the same cupola is not feeding iron to the same furnace, as a result good mixing and uniformity are obtained.

Iron is tapped from the electric furnaces at 2850 degrees Fahr. into covered and insulated ladles, which convey it to the foundry where it is poured from covered and insulated ladles into molds. (Described in the January, 1933 issue of THE FOUNDRY).

Analysis of the electric furnace iron is as follows: Carbon, 2.70 per cent, silicon, 1.10 per cent; manganese, 0.40 per cent, phosphorous, 0.060 per cent; sulphur, 0.110 per cent.

Sprues from electric furnace iron are poured at short intervals, permitted to cool slowly, broken and examined. The examination of these sprues is an important factor in the control of the process, as certain raw materials or variation in practice may produce different types of iron with identical chemical analysis. Under normal operation the furnace doors are left open as we have found that an oxidizing atmosphere must prevail in the furnace or the carbon will be thrown out of solution thereby producing mottled iron. With this condition there is no change in the analysis of the ordinary elements, but no doubt a careful analysis for oxygen content would show less to be present in the iron when operating under reducing conditions with the doors closed. Evidently oxygen increases the solubility of carbon in the iron and is essential to good operation from a standpoint of rapidity of annealing as a higher silicon content can be carried without mottling. Certain raw materials impart similar characteristics to the iron. The usual steel practice is to operate with a slag over the bath. Several (*Please turn to page* 46)

Code Authority Requests Exceptions

Presents budget for 1934 and asks that all gray iron producers be asked to share expense

NO OPPOSITION to proposed amendments to the approved code for the gray iron foundry industry, other than a short written statement of exceptions filed by the automotive parts and equipment manufacturing industry code authority committee developed at a hearing in Washington on May 31. The hearing was held at the Raleigh hotel before Assistant Deputy Administrator J. R. L. Santos, assisted by Morton Steinberg for the legal division, E. C. Henn of the industrial advisory board and others. Presentation of the case was made by H. M. Halsted Jr., executive vice president of the code authority.

At the outset Mr. Halsted took up the proposed amendment of paragraph three of section 4(a). According to an administrative order, firms whose principal products are not governed by a code need not contribute to the support of that code. Mr. Halsted asked that an exception be made to this in the foundry code as many of the firms could claim immunity from necessary contributions under that order. In explaining that an exception be made Mr. Halsted said that the amendment was offered by the code authority itself and stated that in the first instance the code authority had believed that it had the power to assess and collect code assessments.

Limited to Contributing Members

In Section 4(b) Mr. Halsted asked that the following be inserted "Only members of the industry contributing to the expenses of administration of the code as hereinafter provided and otherwise complying with the code shall be entitled to participate in the selection of the members of the code authority or to receive the benefits of any of its voluntary activities or to make use of any emblem or insignia of NRA." There was some discusion on this point and Mr. Steinberg seemed to think that this section could not be inserted in the code although no disposition was made of the question.

In connection with the requested exception from the executive order that some firms need not pay assessments Mr. Halsted gave some pointed examples as to how this would work out. He cited one Rhode Island city where five foundries are located. They are all competing, he said, and yet under the executive order only one out of the five shops would have to pay assessments to the gray iron code authority while the other four, who do nine tenths of the business, would not have to pay any assessments to that authority. He also said that some of the companies which would be exempted from assessments would have the largest tonnage. Asked by the deputy administrator what exceptions would be allowed by the code authority if NRA grants the exception asked to the executive order Mr. Halsted stated that each case would have to be worked out individually and that he could not lay down any specific rule.

Presents Itemized Budget for Years

In submitting the budget for administration of the code Mr. Halsted stated that it covered the period from Feb. 10 to Dec. 31, 1934 and totaled $107,923.40. It includes salaries for 11 people, $32,045; legal expense, $6750; office rent, $2500; furniture and office equipment, $4800; postage and mailing, $2300; telephone and telegraph, $3650.38; stationery and printing, $3626.02; office travel, $5852; code authority meetings, $10,800; directors' meetings, $6300; cost accounting methods, $10,000; committee meetings, investigations, etc., $9800; and district organization and supplemental code authorities, $9500.

The code authority asked to make assessments on members of the code at the rate of ¼ of 2/10 of 1 per cent net sales for the calendar year of 1933 which, he stated, is equivalent to a quarterly assessment of 50 cents on each $1000 net sales.

He was questioned on several items in the budget including that on legal expenses and cost accounting methods. He stated that the legal expenses did not include any precode legal expenses and on the item of cost accounting he explained that it will cost more than $10,000 for this item. He said that a detailed cost accounting system is now being worked out for the industry and it may be necessary to work out industry costs by districts. Several schemes are being worked out now (*Please turn to page* 44)

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Shrinkage Cavities Result From Improper Melting and Gating

We are sending a bronze sample from a 2½-inch solid bushing. The mixture is 85-5-5-5 and consists of 50 per cent ingot and 50 per cent returned runners. It is melted in a gas furnace and phosphor copper is used as a flux. The bushing was poured vertically with the runner about one-half inch from the top end. The metal was tough and clean until it was machined down to its present diameter when it became mushy and broke into several pieces. We have noticed this mushy weak center in several of our solid bushings, from 2 inches to 4 inches in diameter, and we would appreciate an explanation of its cause and a remedy for it.

The simple casting of 2½-inch solid bar is a typical example of the lack of feed, combined with the effect of improper melting of the metal. To make a sound bar of that size, it must be fed with proper risers, otherwise shrinkage cavities are bound to occur, in which will be found the discolored mushy metal visible in the casting submitted.

Much of the trouble can be obviated by proper melting, since the gases which are dissolved during melting are thrown out of solution during solidification. They discolor the surface of the crystals and the fracture exhibits this discoloration. Therefore, melting should be accomplished as rapidly as possible. An ample supply of oxygen must be available to burn the fuel completely, thus raising the temperature to a point where the speed of melting is increased, as well as producing a minimum amount of unburnt gases. It is only the unburnt gases that are soluble in the metal, and therefore it is advisable to have plenty of oxygen passing through the furnace to insure the complete combustion of all fuel.

We believe that you would improve your product by gating the casting at the bottom, having a riser at the top, and flowing the metal through the casting. Of course, the riser must be of ample size to insure the casting solidifying previous to the riser.

Pinholes in Brass Casting Caused by Loose Sand in the Mold

We are sending you a small brass casting which shows pinholes on the cope surface. We employ a gas furnace for melting, and do not use any flux. How can the holes be avoided?

Examination of the casting leads to the opinion that the pinholes are what more commonly are termed sand holes, which result from careless molding practice. The sand or dirt may result from not cleaning out the mold properly before closing, slight cutting of the gate, etc. Possibly it may result from leaving the molds stand too long before pouring especially if the sand is on the dry side. That permits the sand to dry out and crumble, particularly on the sharp edges of the joint, and we notice that there are several places where the sand has fallen off. Of course, that may have occurred before the mold was closed, but we believe that it happened during closing of the mold, and that sand was carried up on the rising stream of molten metal.

Small Motor Castings Show Hard Spots on Edge of Bracket

We have had some trouble with small motor end bell castings 6¼-inch diameter and approximately ⅛-inch thickness of metal. Small hard spots show up in the light bead on the rim and interfere with the machining operation. The iron is melted in a 30-inch cupola and is made up in 500-pound charges containing pig iron 300 pounds, remelt 150 pounds and yard scrap 50 pounds. Analysis of the pig iron shows silicon 3.13 per cent, sulphur 0.025 per cent, phosphorus 0.55 per cent, manganese 0.85 per cent.

We believe that your trouble is due to the composition of the iron plus a higher blast than necessary. Assuming that the silicon content of

the yard scrap is 2 per cent and that of the remelt is 2.40 per cent, the resulting iron would show a silicon content of 2.77 per cent. Loss in silicon under the influence of a high blast might amount to 30 points, leaving only a silicon content of 2.47 per cent in the castings. Aggravated by the high manganese, 0.85 per cent, this metal is on the danger line of chilling when poured into a thin section in a green sand mold. The hazard is increased to a greater extent where the sand is exceptionally fine, damper than usual, or rammed hard.

Temporary relief may be obtained by reheating the castings to a bright red and then allowing them to cool slowly. Permanent relief may be secured by raising the silicon content either by the addition of silvery pig to the charge, or by the addition of ferrosilicon either in the cupola or in the ladle. Reduction in the blast will reduce the amount of silicon lost in the melting process. Pig iron with a lower manganese content would serve your purpose satisfactorily and remove one of the contributory factors toward hard castings. A mixing ladle under the spout will insure a more homogeneous metal.

Small Cupola Requires Less Air for Good Operation

We are erecting a 27-inch cupola lined to 16 inches and equipped with three 3 x 9-inch tuyeres. The blast pipe is 6½ inches in diameter and the blower has a capacity of 500 cubic feet of air per minute at 6 ounces pressure. We shall appreciate information on: (1) What pressure should be maintained in the windbox, (2) Weight of bed and succeeding coke charges (3) Weight of first and succeeding iron charges, (4) Weight of limestone and time of charging.

A pressure of 4 ounces in the windbox is sufficient for a 16-inch cupola. Capacity of the blower is greater than required in the present instance. On the basis of 10 pounds per square inch a 16-inch cupola should melt about 2000 pounds per hour, and on that basis an output of 500 cubic feet per minute would be required from the blower. However, in actual practice small cupolas do not melt on a comparative basis, as rapidly as large cupolas.

After one or two trials you can throttle down the blower either by changing the speed or by placing a gate in the blast pipe. For a small cupola the coke bed should extend from 36 to 40 inches above the tuyeres at the time charging commences. Succeeding coke charges will weigh from 25 to 30 pounds. No particular advantage is gained by the use of a heavy first charge of iron, succeeded by lighter charges. Better operating conditions are secured by using uniform weight charges throughout, in this instance 200 pounds of iron broken into small pieces. If the heat does not extend over 40 or 50 minutes, no limestone is required. About 5 pounds per charge will serve to flux additional charges.

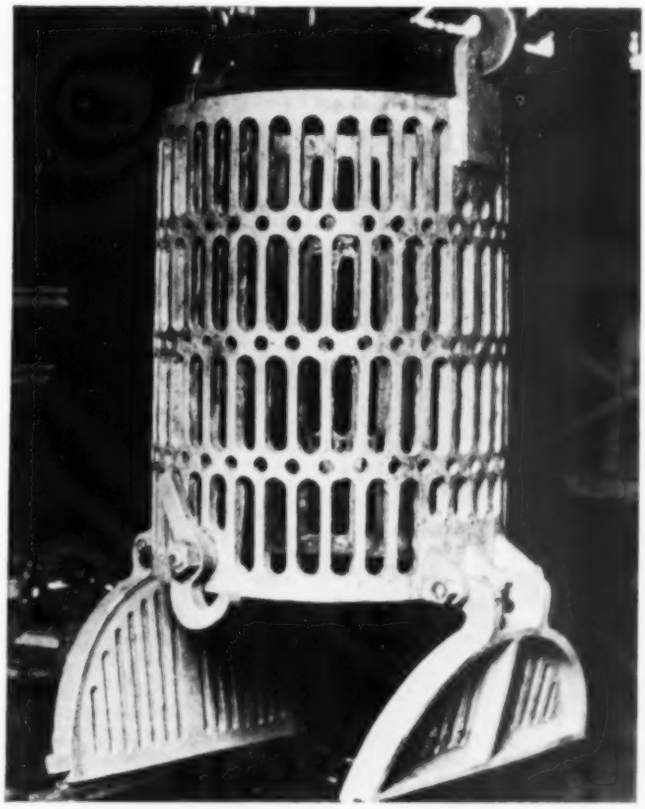
Chemical Control Needed To Govern Ratio of Zinc to Copper

We are about to cast turnbuckles from manganese bronze, as per U. S. navy specifications and contemplate using ingot metal only. In your opinion will castings from this alloy meet the physical requirements?

Making cast turn buckles to meet navy specifications means that the same care must be applied to their production as would be to the production of the test bar that indicates the high tensile strength demanded by the navy specification. These turn buckles, if not properly fed will not stand the strains and will be condemned, just as a heat of metal would be condemned if the test bar did not test up to standard.

In using a good grade of manganese bronze ingot for this purpose, the control of the production of these castings must include the control of the proper amount of zinc within the alloy. In other words, in melting these ingots, a certain amount of zinc is lost thereby changing the ratio of zinc to copper and altering the physical properties of the material.

A chemical control must be established to in-



Specially designed basket of alloy steel castings which is used to carry chisels into an annealing oven. Illustration courtesy National Alloy Steel Co., Pittsburgh

sure the proper ratio of zinc to copper so that the resulting castings will be true to formula and thus insure a bronze that is up to the chemical specification so that the physical requirements will be met. Every precaution must be taken to insure feeding of these castings adequately and to avoid any possibility of blow holes or shrinks, which would tend to reduce the strength or impair their value in the service intended. Proper gating, proper melting and proper pouring consequently are vital.

Gate Should Enter At Bottom of Casting

We are making brass water nozzles which are 12½ inches long, 3½ inches in diameter at the large end, 2⅜ inches in diameter at the small end, with a 3/16-inch wall thickness. The nozzles are poured on end with the gate entering the mold cavity 2 inches from the bottom, and a riser is taken off at the top. These castings are tested under water pressure and we are having trouble with leakage through small pin holes which occur practically all over the upper half of the casting. Are these pin holes due to the core being made from burnt sand? We would appreciate a mixture for this kind of work.

Difficulty with the casting apparently is not caused by the core since trouble arising from that source is indicated by blow holes rather than by small pin holes. Such pin holes are more often caused by the presence of aluminum in the alloy, or from having the metal in the furnace too long; thus permitting the alloy to absorb furnace gases. The gases are thrown out of solution when the metal solidifies and produce the pin holes.

You do not state the mixture you now are using, so that it is difficult to decide wherein the fault lies. Most of those nozzles are made from a yellow metal, which makes the castings more difficult to produce and increases the number of defective castings, thus increasing the cost of those that are acceptable. A good grade of red brass, such as the alloy containing 85 per cent copper, 5 per cent tin, 5 per cent lead and 5 per cent zinc properly melted, should give no trouble and produce highly satisfactory castings.

Your method of gating could be improved materially by having the metal enter at the bottom of the casting instead of an inch or two up from the bottom. A further improvement would be to place a small basin at the bottom of the pouring sprue, which would hold the first metal slopped into the mold before pouring becomes steady, and having a riser at the top of the nozzle sufficiently large enough to insure the flowing of ample metal through the mold, so as to cause the entire casting to approximate a uniform temperature.

Any good grade of core that is well made and is well vented should give good results when used in a mold where the casting is made on end as you described. The vent of such cores should be ample and the vent from the cores should connect with a good vent through the mold so as to insure a free passage for all gases generated. When pouring the mold, be careful to maintain an unbroken stream that produces a steady pressure on the flow of the metal into the mold. The mold should be well vented and the sand must not be allowed to accumulate old cores that generate gases or have too high a moisture content, which would generate steam. With those precautions there should be no trouble in producing satisfactory nozzle castings.

Should Not Heat To Elevated Temperatures

We recently began melting aluminum in an iron pot and are experiencing considerable difficulty due to excessive shrinkage. The pot is kept under heat continuously and as the molten metal is taken from it, it is replaced with cold metal so that the pot is full at all times.

It is difficult to say definitely what is the cause of the excessive shrinkage in the aluminum or rather aluminum alloy that you are using because essential information to form an opinion is lacking. However, it is our opinion, assuming that the alloy you are using is the 8 per cent copper-92 per cent aluminum alloy, that the trouble is due to a combination of overheating, stewing, and iron pickup. Surface shrinkage is increased and trouble in machining is encountered in that alloy when the iron content exceeds 1.5 per cent.

If your pots are not cleaned out every night and coated with a thin solution of whiting or lime containing some water glass before using again, iron pickup by the molten metal will increase. Also when the temperature of the molten metal increases, the tendency toward iron pickup increases. Permitting the metal to stew in the pot for long periods under elevated temperature is bad practice. You will obtain better results if you want to continue the practice of keeping the pot full, by maintaining the temperature at a point which will just keep it liquid. The liquid metal then is transferred to another pot where it is raised to the pouring temperature. If you do not have a pyrometer to determine your metal temperature, you will find it worthwhile to purchase one. Do not heat your metal more than 50 to 100 degrees above the temperature necessary for pouring. Pouring temperatures for different types of castings are determined experimentally, using a pyrometer and examining the resulting castings.

Heat the Chills Before Placing in Molds

Some of the coil chills and horseshoe nails remain in our molds for 10 to 12 hours before the castings are poured. They seem to draw moisture and result in blowholes in the castings. The shop is not heated and consequently in winter the air frequently is at or below freezing temperature. Is there any liquid in which the chills might he dipped to prevent that condition?

In the majority of instances, a little moisture in itself will not cause the castings to blow. The moisture evaporates before the mold is filled. The danger lies in the rust or oxide film developed on the surface of the chills by the moisture. In this connection it is pertinent to point out that rusty chills sometimes are placed in molds and are responsible for blowholes that are blamed on moisture deposited in the mold. The remedy for this condition is to use none but absolutely clean chills. Heat them as hot as is possible to handle them with the bare hands and dip or spray them in or with kerosene oil. This theory is based on the assumption that the sand is warm, at least much warmer than the cold chills used at present. The chills attract and condense a certain amount of moisture in the same manner that a cold water pipe condenses moisture in warm atmosphere.

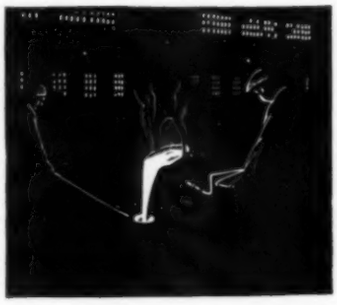
Usually Designated As Hard Gear Bronze

Can you supply the formula for United States standard No. 9 bronze?

The United States master specification 172a for bronze castings includes a No. 9 bronze which is a hard bearing metal usually designated as hard gear bronze. The permissible range of constituents are as follows: 84 to 86 per cent copper, 13 to 15 per cent tin, 0 to 1.5 per cent zinc, 0 to 0.20 per cent lead, 0.10 per cent maximum iron, 0.75 per cent maximum nickel, 0.05 per cent maximum phosphorus, 0.5 per cent maximum sulphur, and 0.15 per cent maximum antimony. The minimum tensile strength for the alloy is given as 30,000 pounds per square inch, and the elongation in 2 inches ranges from 1 to 8 per cent.

Viewing Foundry Developments

At Short Range



SIZE of metal pieces charged into the cupola is an important factor in proper melting control. One authority has recommended that no piece be charged which has its longest dimension more than one-half the diameter of the cupola. In his estimation, pieces with measurements not exceeding one-quarter of the diameter probably would give most satisfactory results.

♦ ♦ ♦

Conveyor screws, containing on the average 1.50 per cent nickel, 0.75 per cent chromium and 0.30 per cent carbon, have been in constant service in a cement mill for over 4 years, handling clinker at temperatures frequently approaching 1000 degrees Fahr. Fabricated screws used previously required replacement about every week or ten days.

♦ ♦ ♦

A SIMPLE and highly effective type of gate is employed for conducting metal into small tablets and other thin nonferrous castings. Two half cores with the sprue, runner and gate cavities formed in opposing surfaces are pasted face to face. The core is placed upon the center of the cope face of the pattern and the remainder of the cope is filled with sand and rammed in the usual manner. After the cope is lifted off any loose sand that may be present is removed from the gate passage with a bellows or a jet of compressed air.

♦ ♦ ♦

According to a recent patent graphite which has a varying coefficient of heat transmission depending upon its temperature, can be employed with molding sand to obtain controlled chilling effects in nonferrous castings. It is stated that if sand is assumed to have a coefficient of heat transmission of 1, graphite has a factor of 180, cold, and 470 at 555 degrees Cent (1031 degrees Fahr.). In application no graphite is employed in the sand where ordinary cooling conditions are desired. Where more rapid cooling is wanted, varying quantities of graphite are added depending on the effect desired.

♦ ♦ ♦

Solubility of copper in cast iron alloys is influenced greatly by the presence of other elements. With from 12 to 15 per cent nickel, as much as 6 to 7 per cent copper is dissolved readily and an alloy containing those proportions of the two elements is one of the important of the austenitic cast iron. Ordinary cast iron will dissolve between 3 and 4 per cent copper.

♦ ♦ ♦

WHERE cores are made in considerable numbers, in halves and later pasted or booked, a vent passage on the joint is formed by pressing a plate on the green face. A raised ridge on the plate of any desired shape and depth leaves an impression in the sand. Suitable holes in the ends or sides of the plate corresponding to the guide pins on the half corebox insure an accurate setting of the vent passage.

♦ ♦ ♦

Magnesium will oxidize very easily and castings may start to burn while being heat treated. All parts must be free from dust, and any substance which may start to burn. The furnace should be sealed to prevent circulation of fresh air.

♦ ♦ ♦

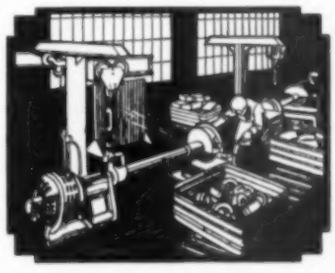
A recent new use for molybdenum alloy cast iron is in brake drums for cranes. One user has already had twice the life over that of his former steel drums and finds them still in good condition with very little signs of wear. The analysis of the drum is: Total carbon, 2.90 per cent; silicon, 1.90 per cent; manganese, 0.75 per cent; sulphur, 0.09 per cent; phosphorus, 0.11 per cent; molybdenum, 0.50 per cent.

♦ ♦ ♦

SLAG reaction is an element of both time and temperature. Slags ineffective at low temperature may prove active scavengers at increased heat ranges. Occasionally metal tapped from an electric or open-hearth furnace in a pure state will be contaminated by slag reaction from ladle linings.

♦ ♦ ♦

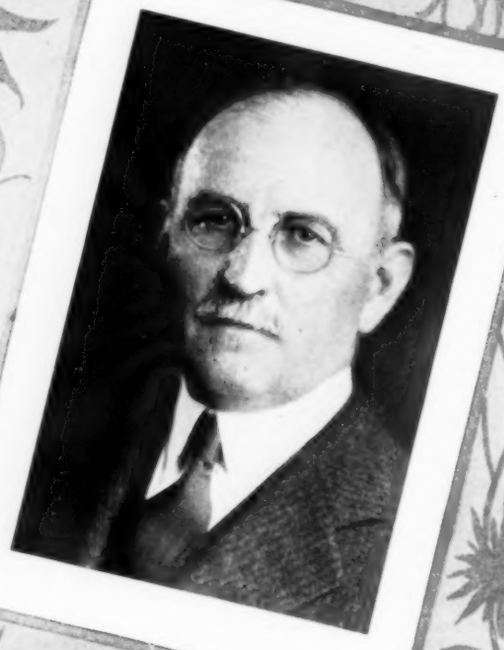
Obtaining a suitable patina on bronze by artificial methods is difficult, but according to a recent patent troubles are overcome through applying ammonium sulphate solution to the work and exposing it to the atmosphere in cycles. Best results are obtained by dipping the bronze in an aqueous bath containing from 5 to 10 per cent ammonium sulphate heated to 50 to 75 degrees Cent. (121 to 167 degrees Fahr.) for 4 seconds and then exposing it to the atmosphere for 2½ minutes; repeating the cycle until the patina is obtained. In some instances a hot, humid atmosphere promotes formation of the desired green patina.

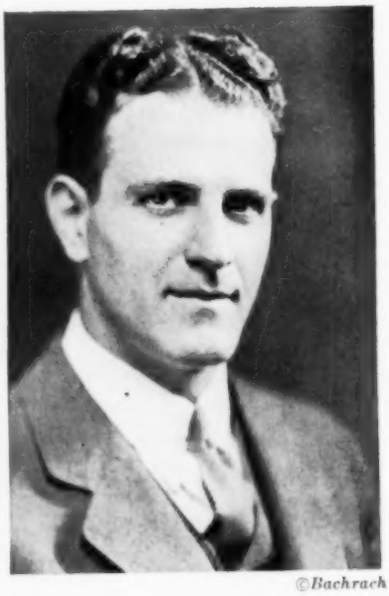


♦ ♦ ♦

The stabilizing effect which chromium exerts on carbides is especially useful in resisting growth in cast iron after repeated heatings. In general, certain investigators have found that 1.50 per cent chromium retards volume changes up to 1600 degrees Fahr., and therefore is used for annealing pots, ingot molds, grate bars, etc.

The FOUNDRY Family Photograph Album





Upper Left
HARRY RAYNER
Chrysler Corp.
Detroit

Upper Right
A. E. MCKINSTRY
International
Harvester Co.
Chicago

Lower Left
L. B. KNIGHT JR.
National Engineering Co.
Chicago

Lower Right
C. M. SAEGER JR
Bureau
of Standards
Washington

Men of Industry

Whose Activities Are Making Foundry History

DAVID P. WILLIAMS has been elected vice president of the Vulcan Mold & Iron Co., Latrobe, Pa. Mr. Williams was graduated from Yale university in 1925 and has been active in the company since that time. His father, the late Col. E. H. Williams, was founder and former president of the company, and his brother, Edward R. Williams, now is president.

ARTHUR E. SCHNELL, for the past 2 years supervisor of the valve department, Aluminum Industries Inc., Cincinnati, has been made plant superintendent.

S. WELLS UTLEY, president Detroit Steel Castings Co., Detroit, spoke on "What's Ahead for Business," at a luncheon meeting of the Savoyard club, Buhl building, Detroit, on May 31.

N. E. DAUB, formerly associated with the Atlantic Foundry Co. and the Adamson Machine Co., Akron, O., now is resident sales representative at Akron for the Massillon Steel Casting Co., Massillon, O.

JOHN ALBERTS, Plainville Casting Co., Plainville, Conn., discussed the production of light and medium gray iron castings at the regular meeting of the Connecticut Foundrymen's association held May 18 at the home club, Meriden, Conn.

DR. BRUCE W. GONSER recently was appointed a member of the technical staff of Battelle Memorial institute, Columbus. Dr. Gonser was graduated from Purdue university, Lafayette, Ind., in chemical engineering, received his master's degree from the University of Utah, and his doctor's degree in metallurgy from Harvard university.

H. G. BUGHMAN JR., formerly secretary and treasurer of the Union Spring & Mfg. Co., New Kensington, Pa., has been elected president of the company, succeeding the late L. G. Woods. He will continue as treasurer. F. D. SCHAEFFER has been elected secretary, W. F. MCCABE, vice president, and A. M. MCCREA has been elected to a newly created office of chairman. DU RAY SMITH has been named general manager.

DAVID ADAM has been appointed Pittsburgh district sales manager of the Falk Corp., Milwaukee, succeeding W. O. Beyer, recently resigned. Mr. Adam has been with the Falk Corp. for the past 4 years in the sales department at Milwaukee, and previously was connected with the National Malleable & Steel Castings Co., Sharon, Pa. and W. A. Riddell Co., Bucyrus, O. in charge of foundry and sales. The Pittsburgh office is in the Grant building.

FRANK A. TRUEL, formerly general foreman of the gray iron department of the Belle City Malleable Iron Co., Racine, Wis., has been made general superintendent of the Midway Foundry Co., St. Paul. Previously Mr. Truel has been foundry superintendent Municipal Foundries Inc., West Allis, Wis., Neenah Foundry Co., Neenah, Wis., Lakeside Foundry Corp, Milwaukee, and general superintendent, York Foundry & Machine Co., York, Pa. Mr. Truel is a graduate of McLain's System Inc., Milwaukee.

CLYDE E. WILLIAMS has been appointed director of the Battelle Memorial institute, Columbus, O., and DR. H. W. GILLETT, has been made chief technical adviser. Both Dr. Gillett and Mr. Williams have been associated with the institute since 1929, Dr. Gillett as director, sharing the administrative duties of the directorship with Mr. Williams as associate director, and at the same time serving as metallurgical supervisor of the institute. Dr. Gillett now will devote his entire time to the scientific side of the work where his technical knowledge and ability will be utilized to the fullest extent on the institute's own projects and its sponsored projects for industry. A greater range of research and development work within the institute has been planned, and in addition, many new projects of outside sponsorship recently have been accepted.

FREDERICK J. FAY has been made foundry superintendent of the Tolhurst Machine & Foundry Co., Green Island, N. Y., formerly the Sweet & Doyle Co., and has charge of both ferrous and nonferrous shops. Mr. Fay formerly was foundry superintendent of the Poughkeepsie Foundry & Machine Co., Poughkeepsie, N. Y., and previous to that was foundry superintendent of the Finch Mfg. Co., Scranton, Pa., the Gifford-Wood Co., Hudson, N. Y., and foreman and metallurgist, Dodge Co., Mishawaka, Ind.

SPENCER HAZARD, formerly vice president, secretary and treasurer, has been appointed president of the Florence Pipe & Foundry Co., Florence, N. J., succeeding the late Walter Wood. EDWIN J. LAME has been named vice president in charge of sales and E. ROY RUSSELL, secretary and treasurer. The latter was formerly assistant secretary and treasurer and is succeeded by JOHN J. TROSTER. Will of the late Mr. Wood provides that all stock, both common and preferred, of the Florence Pipe & Foundry Co. be offered to employes at one-half of par, with the unsold stock going to the company. The Florence foundry employs between 800 and 1100 men.

Company Elects Two Vice Presidents

Lester B. Knight Jr. (see FOUNDRY Album on page 32), for the past 2 years sales manager, has been made vice president and sales manager of the National Engineering Co., Chicago. Mr. Knight became connected with the National company in 1930 and previous to that was affiliated with the Illinois Clay Products Co., Chicago.

A. C. Christensen has been made vice president and chief engineer of the National Engineering Co.

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE — *Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Shows Pouring Basin

TO THE EDITORS:

The series of articles "Prevent Losses with Proper Gates and Risers" which has appeared periodically in THE FOUNDRY over the past 3 years is one of the most interesting and instructive series ever presented.

The accompanying illustration shows a skimmer type pouring basin which the writer has used with marked success for over 20 years in the production of clean gray iron castings. The cost is negligible since a girl can make 100 cores per hour and one man can prepare from 70 to 100 molds for pouring in about 15 minutes. In many instances the extra metal in the pouring basin may be drained through a suitable flowoff and in this manner the cast iron runner cup may be used repeatedly during the same heat. A runner of the dimensions shown may be used on castings up to 150 pounds in weight. With suitable adjustments in the number and size of gate openings, the pouring basin may be adapted for use on larger castings. Of course care must be observed to see that the cast iron runner basin is perfectly dry. Usually it is lightly coated with oil before it is placed in position above the shallow skimmer core which in turn rests on the face of the cope with the strainer openings immediately above the sprue opening.

VICTOR N. CLYNE

1205 *Buena Vista Street,*
Pomona, Calif.

Crystallization

TO THE EDITORS:

A metallurgical error has been committed in a very interesting article reflecting credit on its author, entitled "Ford Foundry Cast V-8 Crankshafts" in your April, 1934, issue. In the interests of a desirably correct understanding of the behavior of metals I feel that the mis-statement should be pointed out.

I quote the sentence to which exception is taken: "Up to the present time none (of the cast crankshafts) has failed in service, none has shown distortion or appreciable wear, and none has shown defect of fiber stress or crystallization, a form of defect usually associated with ferrous metal subjected to constant revolution and vibration and commonly known as fatigue of metal."

It was learned long ago that crystallization in metals is not caused by mechanical stress, but is produced as the final result of high temperature application. Formerly, when the fracture of a broken piece of steel apparently exhibited an unsatisfactory condition of a certain kind, it was declared frequently that the steel had crystallized as the result of fatigue. Subsequently it was ascertained very definitely that fatigue does not develop a change in the granular structure; and that a supposedly unsatisfactory condition that was described often as crystallization undoubtedly obtained in the metal part as the result of its manufacture.

Certainly it is desirable to prevent old misconceptions from being restated as facts.

R. A. BULL

541 *Diversey Parkway*
Chicago.

Wants Each Issue

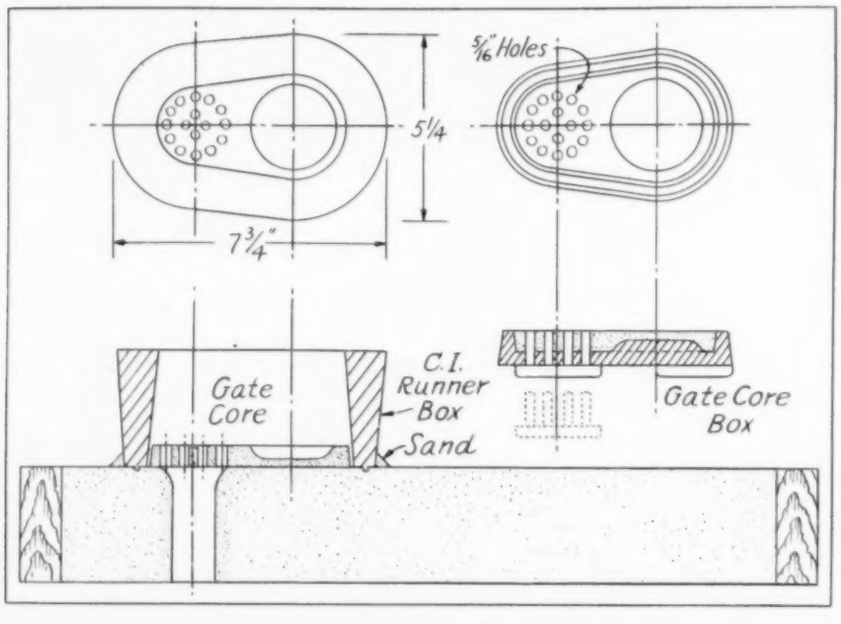
TO THE EDITORS:

I received my March and April issues of THE FOUNDRY promptly, but have not received my May issue as yet. Why?

I don't want it held up another day, even if I have to pay extra for it.

P. J. MURRIE

219 *Sixth street,*
West Newton, Pa.



Sectional view of cast iron runner basin and skimmer core in place. Upper right—Plan and sectional view of corebox

Detroit Group Holds Annual Meeting

The annual meeting, banquet and ladies' night of the Detroit Foundrymen's association was held at the American Legion ballroom, Detroit, on May 17. At that meeting the following officers were inducted into office: President, Harry Rayner (see FOUNDRY Album, page 32), Chrysler Corp.; vice president, Vaughan Reid, City Pattern Works; secretary, Harry J. Deutsch, Aluminum Co. of America; treasurer, Frank X. Mushynski, American Car & Foundry Co.; members of the executive committee, Ira F. Cheney, Griffin Wheel Co., and Fred J. Walls, Eaton-Erb Foundry Co.

The retiring president, Fred J. Walls, was presented with a set of golf clubs in appreciation for his work during the past year. The reorganization of the association as a local section of the American Foundrymen's association was discussed and the matter referred to the executive committee for action.

Independent Foundry Supply Co., Los Angeles, has moved to new quarters at 2143 Bay street. Steven Mocsny is manager.

Does your **ABRASIVE SEPARATOR** *clean the dirt and dust from your* **USED ABRASIVE . . . . . ?**

A Pangborn Separator added to your present equipment will repay its cost many times over in reducing abrasive waste and providing quicker finishing.

1

Does your **BLAST MACHINE** *keep a continuous stream of abrasive blowing at a* **CONSTANT PRESSURE . ?**

Economical Blast Cleaning depends upon consistent abrasive flow from nozzle opening at a predetermined cutting velocity. A new Pangborn "AU-11" Blast Machine will bring you this profitable performance at little cost.

2

Are the **DOORS** *to your* **BLAST ROOM** *tight sealing, or does* **DUST** *seep through to endanger other employees . ?*

Equip your Room with the new Pangborn self sealing, self closing, adjustable Room Doors that are positively AIR TIGHT, and forget the trouble and expense of dust leaks, unhealthful shop conditions, etc.

3

Are you satisfied with the efficiency and economy of your **DUST COLLECTOR?**

The new Pangborn Type "CH" Dust Collector has 14 outstanding features to guarantee you complete satisfaction. You can easily adapt your present collector to this type at but little expense. *Write for complete information.*

4

PANGBORN CORPORATION

HAGERSTOWN . . . . MARYLAND

Prevent Losses with

Proper Gates and Risers

BY PAT DWYER

DISCUSSING the methods pursued in a prominent eastern steel foundry during an intensive campaign directed toward the reduction of foundry losses, J. M. Sampson presented the accompanying table in an article which appeared in THE FOUNDRY in two sections April 1 and April 15, 1927. This tabulation covers a six month period in which the total rejection by weight for all causes in the foundry and machine shop amounted to 6.72 per cent. Out of this total, castings to the extent of 3.87 per cent were condemned in the foundry. The flaws were apparent and the castings had no further work or effort expended on them. Of the remaining 2.85 per cent more or less machine work was involved before the hidden defects were disclosed with a consequent rejection of the castings, delay and added cost.

The significant feature, so far as the present series of articles is concerned, is that the first four items: Shrinkage holes, blowholes and porosity, dirt and slag, and cracks, account for 74.81 per cent of the 2.85 per cent group which escaped detection in the foundry and which incurred further operating expense in the machine shop. All, or practically all these defective castings resulted from improper shape, size, number or position of the gates and risers. A number of typical examples are shown in the accompanying illustrations to indicate the character of the defect, the causes, and the remedial measures adopted. In these particular instances comparatively small castings have been selected, as typical of a large class in which surface appearance alone is not a sufficient passport. These castings must be absolutely clean and solid throughout.

Make Sample Castings

In this particular shop, and in others where the volume of work warrants the expense, one man devotes his entire time to following all new and doubtful castings from the inception stage to the final delivery from the machine shop. In this way a close check is kept on concealed shrinkage defects including cracks and porosity.

Try Many Methods

CONTRARY to a general belief, large steel castings do not present any more hazards or difficulties in the foundry than many small and apparently simple castings. Usually a large or a number of large risers may be disposed over a large casting in a manner to feed it adequately. In small castings, particularly those of unequal section throughout, the metal in certain sections freezes so rapidly that the riser or risers cannot function satisfactorily. The exterior surface may be satisfactory and in many instances a minor cavity in the interior does not detract from the value or usefulness of the casting. However, absolute soundness is required in the majority of castings, particularly those which are machined extensively. In many instances a considerable amount of experimental work is required to establish a method and procedure that will guarantee homogeneous, solid metal in all parts of any given casting.

Wherever possible a sample casting is made, with the gates and risers arranged according to the best method suggested by experience. This experimental casting then is sawed apart at one or more points where shrinkage might be suspected. If no defect is found the pattern is passed for production and a record is made of the pertinent details, including position and height of the gates and risers. If the casting shows a defect or defects, the details of mold construction are changed as often as necessary until a satisfactory casting is produced. Details of all changes are entered on the original record. The case history of several typical castings shown in the accompanying illustrations covers many interesting operations.

The casting shown in Fig. 230 originally was made quite satisfactorily in the malleable foundry. The pattern then was sent to the steel foundry with a rush order for six castings. The mold was gated at *G* and jointed along the line *JJ*. A 4-inch diameter riser was placed on each of the bosses *A*, *B* and *C* and a 3 x 4 x 9-inch riser placed on *D*. Two large horseshoe nails projected into the mold at *F* and six small nails at *E*. Shrink holes were found under the risers *A*, *B* and C.

Case Reports Filed

In a second attempt, 10 large horseshoe nails were placed under the risers at *A* and *C*. Two 80-penny spikes and four large horseshoe nails were placed under the riser *B*. These castings appeared to be quite solid, but shrink holes were found when the boss *B* was drilled. This information was filed with the case report and a recommendation added to increase the diameter of boss *B* to permit the use of a larger riser on any subsequent castings. This was one of the instances illustrating the old saying "More hurry, less speed."

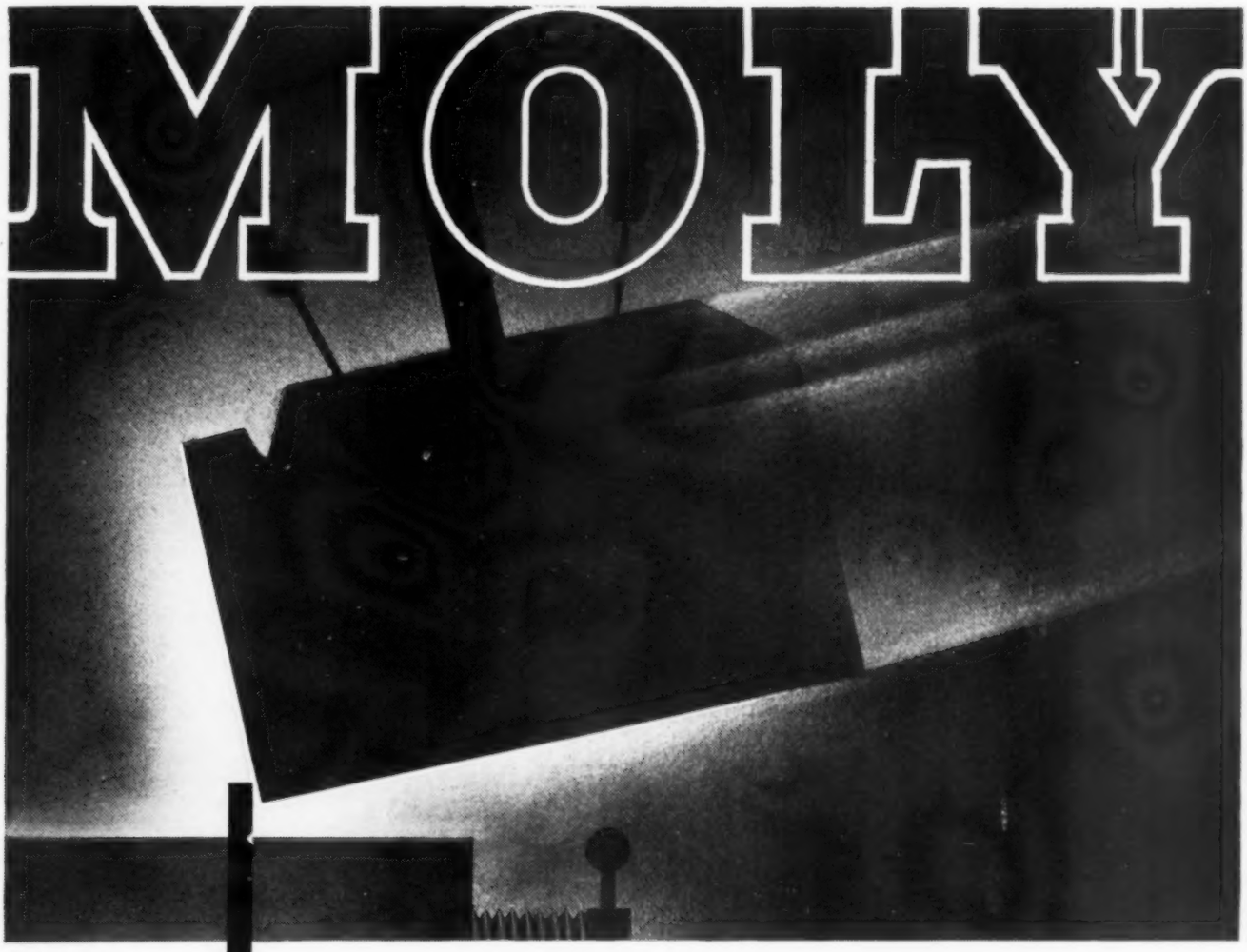
In the experimental stage the casting shown in Fig. 231 proved defective through a number of contributory causes. It was molded in the position shown in the illustration with the parting line at *JJJ*. The metal entered through a single gate at *B*. A single riser 3 inches diameter and 6 inches high was placed at *A*. Flat chills were laid up against the bosses *EE* near the bottom of the mold.

This casting also presented a satisfactory appearance until the bosses *CC* were milled and drilled. Large cavities were disclosed in these bosses. Instead of serving any useful purpose at the bottom the chill actually prevented the riser from functioning in what might be termed the second leg of the casting. The metal solidified in the vicinity of the chills and consequently when the right leg of the casting commenced to shrink it drew metal away from the highest point, the boss *C*.

In the second attempt the chills were omitted at *E* and the riser was

(*Continued on page* 38)

MOLY



The "Izod" test

ELIMINATES TEMPER EMBRITTLEMENT IN STEEL

Embrittlement is the bugaboo of high-temperature steels, and the cause of much trouble when drawing other constructional steels. It can be conquered! A small amount of Molybdenum will retard temper embrittlement, while a .75% addition will completely eliminate this dangerous trouble.

The following comparison of two similar steels, with and without "Moly," shows the effects of this extraordinary alloy when one sample is cooled slowly and another water-quenched after tempering at 1150° for two hours:

Analysis			*Impact (foot pounds)*	
C	*Mn*	*Mo*	*Cooled in water*	*Cooled slowly*
.36	2.24	Nil	74	4
.30	2.30	.52	59	50

In high-temperature installations, a similar condition is often encountered. Why take a chance when the difficulty is so easily and economically overcome?

Molybdenum is one of the greatest discoveries in alloy history. Its many-sided qualities for improving steel and iron have excited the wonder of the engineering and metallurgical world. Resistance to fatigue, shock, creep, abrasion, corrosion and temper embrittlement has definitely been increased under Moly formulae repeatedly tested and proved in service. Machinability of heat-treated steels is economically increased without loss of strength or other essential qualities. *Write for our latest book on Molybdenum.* Discuss your alloy problems with our modern experimental laboratory and engineering service. Climax Molybdenum Company, 295 Madison Ave., New York.

CLIMAX Mo-lyb-den-um

(*Continued from page* 36)

expanded across the dry sand core *K* to cover the second leg of the casting. Under this method the casting was perfectly satisfactory and no further trouble has been experienced.

A considerable amount of stubborn shrinkage trouble was experienced in securing a satisfactory casting from the pattern shown in Fig. 232. The logical place for a riser, so far as feeding purpose is concerned, is on top of the part *B*. However, the foundryman naturally hesitated in placing a large riser on this curved surface on account of the extra labor that would be involved in cutting and grinding.

The mold was made in green sand with the joint line as indicated at *JJJ*. Side risers 4 inches diameter were placed near *B* and *C*. A ½-inch chill rod was placed in the center of the end bosses *D* and the metal was poured down through the side riser at *C*. In the machine shop shrinkage was found at *B*.

In the second attempt the same procedure as at first was adopted with the exception that a gate channel was cut to connect risers *B* and *C*. This introduced hot metal into both risers simultaneously, instead of filling riser *B* with metal that had flowed through the mold. Apparently the slight difference in temperature secured in this manner was sufficient to eliminate the shrinkage trouble encountered formerly.

Casting Apparently Solid

The casting shown in Fig. 233 had been an almost constant source of trouble for several years through the appearance of either shrinkage or gas cavities. The casting was molded in a green sand drag with a dry cope and jointed as shown at *JJ*. A large gate was cut at *E* and a large riser over the top of the casting at *A*. Horseshoe nails were inserted at boss *B* and lugs *C*, *D*, *K* and *P*, in both cope and drag. Small vents known as whistlers were taken from the pads *C*, *D*, *K* and *P*.

In outward appearance the castings were solid leaving the cleaning room,

Castings Rejected

(Six Month Period)

By Weight in Per Cent of 2.85 Per Cent Rejected in Machine Shops

Cause:		
1.	Shrinkage holes	36.66
2.	Blowholes and porosity	10.10
3.	Dirt and slag	14.27
4.	Cracks uncovered (shrinkage mostly)	13.78
5.	Machined wrong	12.01
6.	Pattern shop faults	4.61
7.	Core set wrong	1.74
8.	Cold metal	1.22
9.	Grinding (cleaning room)	1.16
10.	Miscellaneous (mostly engineering faults)	1.26
11.	Shifted	0.89
12.	Burning off (cleaning room)	0.48
13.	Broken in handling	0.45
14.	Core wrong	0.74
15.	Crushed mold	0.63
		100.00

but in the machine shop shrinks and blow holes were found in the boss and pads. Obviously the gate at *E* was not satisfactory. The first change in method included the same type of cope and drag with gate at *J* in drag only, risers at *A*, *C* and *K*, chill nails under the riser at *K* and *C* and in boss *B*.

These castings showed a shrinkage cavity in the pads *K* and *C*, because the metal in the small riser necks solidified prematurely. In the second attempt and the one that finally produced sound castings, the only change from the preceding method included a gate or trough cut in the top side of the cope connecting the two small risers over *K* and *C* with the large riser over *A*. The metal flowing up freely through the large riser ran through this trough and fell into the small risers *K* and *C* thus furnishing relatively hot metal to feed these sections.

An example of a casting which caused trouble through faulty pattern design is shown in Fig. 234. The boss *A* has sharply tapered sides and the finish allowance follows the same taper. To feed the casting through the gate at this point it was necessary to cut the gate practically to the same diameter as the boss. No mark was left for the grinders and burners and as a result many castings were shipped with too much stock ground off the face of the boss. This was remedied by bringing the finish allowance straight out to parallel the boss axis.

Experience with the casting shown in Fig. 235 indicate that blowholes are more prevalent than shrinks in small casings. The castings were molded in green sand and jointed on line *JJ*. A 4-inch riser 9 inches high was placed over *A*, a 3 x 5-inch riser 9 inches high over *B*, one horseshoe nail at *D* and a single gate at *C*. In many of these castings a blow hole was found in the small boss *D*. Apparently a small volume of air, steam or gas was pocketed at this end. The sand may have been a little damper than usual or the metal might have been cold. The trouble was intermittent, but to be on the safe side a small riser was placed over this end and no further trouble was encountered.

Risers were necessary on bosses *B* and *C* and on trunnion *D* to secure the solid casting shown in Fig. 236 As with casting Fig. 234 no mark was left to show the junction of the riser with the trunnion *D*. Out of one shipment of 150 castings, 36 were found to have been ground too low. No change was feasible in the molding method, but a note was filed with the pattern card. Each time the pattern comes into the foundry the burners, grinders, chipping room foreman and inspectors are warned of the danger of burning or grinding this riser too close to the trunnion.

Co-operation Needed

Unwillingness of the machine shop to cooperate through the removal of a little extra metal caused delay and trouble on the casting shown in Fig. 237. This blank gear quadrant was gated at *D* and jointed at *JJ* and was provided with three risers, one 9-inch diameter at *A*, one 5-inch diameter at *B* and one 4 x 7 inches at *C*. All risers 9 inches high. A shrink under riser *B*

(*Concluded on page* 41)

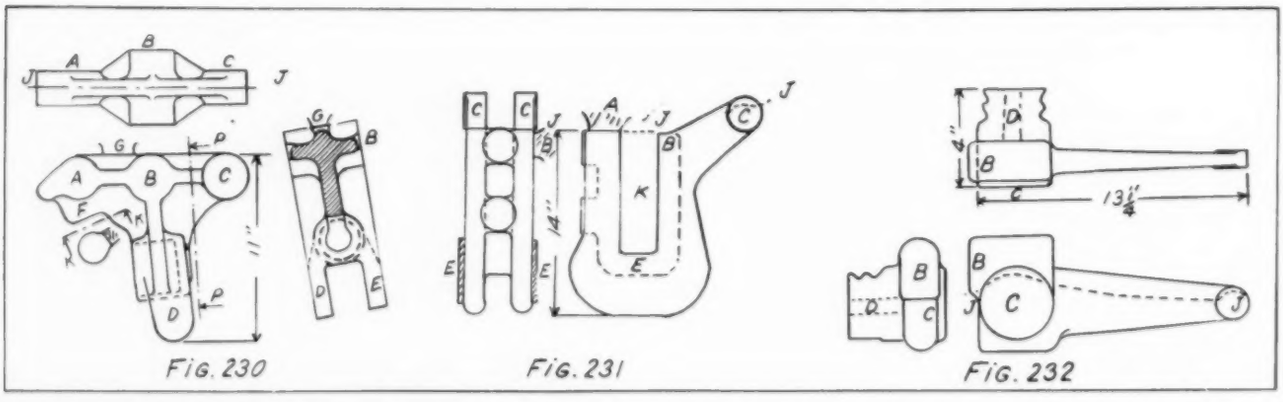


Fig. 230—Casting weight 32 pounds, shrinkage in boss B. Fig. 231—Proper position of riser eliminated shrinkage in boss. Fig. 232—Connection of side risers B and C allowed hot metal to feed B and thus prevent shrinkage

ADVERTISING PAGES REMOVED

(*Concluded from page* 38)

in the first casting was prevented in subsequent castings by placing five nails under the riser.

In cutting the teeth 30 per cent of the castings were found defective in the area under the riser *C*. If it had been permissible to pad the riser *C* in over the web it is probable that this defect would not have developed. In replacing the defective castings the blank for the gear teeth was padded on the outside below the riser. These castings also showed small shrink holes but were welded and used. In a third attempt nails were placed in the affected area. While admitting that this is not good practice, still it is the best solution devised so far since permission cannot be secured to pad on the inside.

An unusually large and unexpected gas or steam cavity was found in the casting shown in Fig. 238 even though ample precaution had been taken through gate and risers to prevent shrinkage. The first lot of castings were made in green sand molds jointed at *JJ* and gated at *F* on the joint. A 3-inch riser was placed on *B*, *D* and *E*. Three small chill nails were placed in the bosses B_2 and D_2 under the core.

Many castings made in this manner apparently were perfectly sound, but in one lot large blowholes were discovered while milling the bosses B_2 and D_2 which had been located in the bottom of the mold and chilled and therefore, presumably, immune to defects of that character. The arm *G* was sawed apart in three places and it was found that the cavity extended the full length from boss B_2 to boss D_2. In fact the arm was a mere shell with a wall thickness varying from 1/16 to ⅛-inch in thickness.

Apparently the mold was damper than usual and the extra amount of steam generated was trapped in the lower part of the mold by the metal which solidified just above it. To anticipate and prevent this form of defect, certain changes were made in the molding method.

Provide Vent Passage

The gate at *F* on the joint was changed to a gate at *A* in the short arm in the drag. The three 3-inch risers on *B*, *D* and *E* remained the same. An ⅛-inch whistler was pierced through the core from boss D_1 to D_2 and a small riser was formed in the core between boss B_1 to boss B_2. Three small chill nails were placed in the bottom of boss B_2 and boss D_2. The object of these changes of course was to introduce the metal so that the mold would fill from the bottom. Also to provide a free exit for any gas or steam that might accumulate in any part of the mold cavity.

As a final example in this particular group the casting shown in Fig. 239 is presented as typical of many which are rejected before a method finally was discovered and applied to produce consistently solid castings. The design of the casting was faulty from a foundryman's viewpoint, insofar as the production of a sound casting is concerned. The bosses are too heavy as compared to the thickness of the metal in the arms, or, to transpose the comparison, the arms are too thin in relation to the thickness of the bosses.

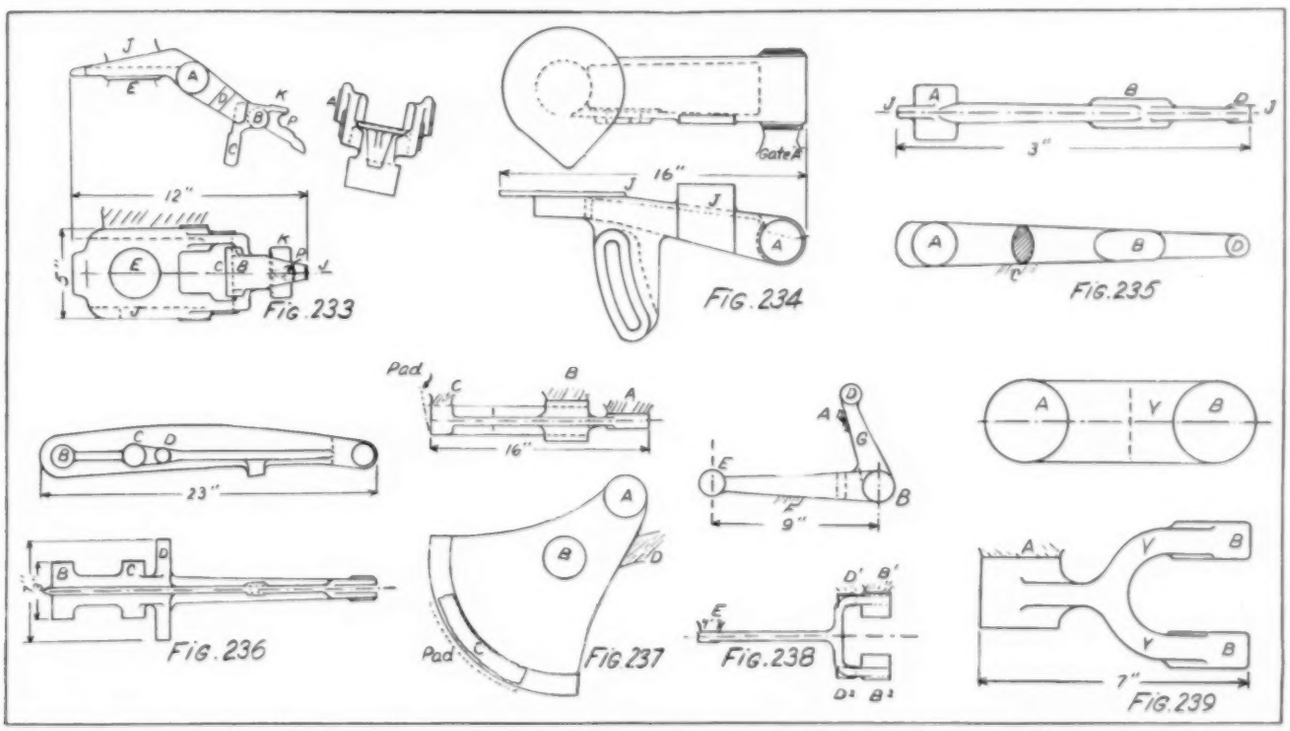
In the original method the pattern was jointed on the center line and was gated at *A*, and fed through a 4-inch sprue 9 inches high. A ½-inch chill rod passed through the center of the bosses *BB* and an ⅛-inch whistler was designed to allow the escape of gas and steam from these bosses.

Blowholes were found in the bosses. Apparently the metal in the arms *YY* solidified before the gas or steam pocketed in the bosses *BB* could be forced out through the whistlers. The thickness of the arms was increased from 7/16 to 9/16-inch and while these castings showed a slight improvement, they were not solid. The same method was employed in making succeeding molds with the exception that the size of the whistlers was increased to ¼-inch. Acting on the theory that increased pressure might force the air out more rapidly and also hold the metal *up* in the bosses until the arms solidified, the sprue was raised from 9 to 15 inches. This change produced the desired result. Out of a shipment of 200 castings none was rejected and only six required minor welding repair.

This is the fifty-third of a series of articles dealing with the various types of gates and risers used in the foundry industry. The fifty-fourth installment will appear in an early issue.—THE EDITORS.

Moves Detroit Office

Chain Belt Co., Milwaukee, has moved its Detroit office to 5169 Martin avenue, adjacent to its warehouse. C. E. Martin is in charge.



Figs. 233 to 239—Illustrating various types of comparatively small intricate castings in which a change of gates, risers and chills was required to secure solid metal throughout the entire structure

Steel Castings for Boulder Dam

(*Concluded from page* 17)

proper relative positions. Mold space between the outer ends of the cores and the mold face was stuffed with waste to prevent sand, dust or other foreign material from falling into the cavity while the molders were setting the remainder of the cores.

Short cores *C* were placed on the flat cores *B* with the outer faces coinciding to form continuations of the ribs. These were followed by the chamber cores *D* with the outer ends resting on the flat cores *B* and the inner ends resting on stud chaplets supported on the cores *C*. The curved outer ends coincided with a similar line on the supporting cores, while the inner ends were adjusted by a slight manipulation of the chaplets to insure a circle concentric with the spindle.

Cope Rested in Cores

Four segment cores *F* Fig. 5 completed the assembly. The shoulder on these cores rested upon the upper flat face of cores *D*. The smaller part of the core completely filled the space immediately above the center core, *E*, while the outer wall formed a continuation of the outer wall of cores *D* to a point flush with the top of the upper cheek. Thus when the cope finally was lowered into place, the face rested on these cores and effectually anchored the assemblage.

Typical construction of a corebox also the method employed for reinforcing the sand to produce a core accurate in size and shape are shown in Fig. 6. Two pairs of lifting hooks are incorporated in the core—one pair for lifting the dried core from the plate, the other pair for lifting it into the mold after it has been rolled through an angle of 90 degrees. After the sand has been rammed to the top of the corebox, the surface is scraped to a true plane with a straightedge resting on the upper face of the box. Bolts in the ends then are taken out and the sides and ends of the corebox are removed from the core.

The relief valve body shown in Fig. 7 and weighing 52,480 pounds was molded and cast in the position shown. In a three part flask the drag extended up to the central parting line. The cheek formed that part of the outer wall of the mold between the central parting line and the top of the upper flange. The lower face of the cope rested upon the upright part of the core and upon the horizontal side print and anchored it firmly in place.

The core was made and dried in eight sections and afterward assembled in the mold. The four lower sections rested in the bottom and side prints with the flat upper face flush with the joint line of the drag. The four upper sections then were lowered into place with outer edges coinciding all the way around. The cheek then was lowered into position, followed by the cope, after which the flask was clamped securely at both parting lines. Openings for the risers above the upper flange were continued below the flange as far as the top of the curved part of the body proper to insure a thorough feeding of this part and the guide for the piston which increased the thickness of metal in this part of the casting.

The work on each of the relief valve and diaphragm castings extended over a period of 2 weeks. Making and drying the mold and cores occupied the first week. On the following Monday and Tuesday the mold was cored and assembled and on Wednesday it was cast. On Friday the casting was lifted out of the pit and taken to the cleaning department and the pit was prepared for the reception of the next mold.

Exhibition Stimulates Early Interest

(*Concluded from page* 18)

either presented papers at the technical meetings or took an active part in the discussions, so that a greater interchange of valuable information was made possible. An American tour has been arranged, as previously announced in THE FOUNDRY, and important European foundrymen now are signifying their intention of being included in the party which will visit this country for the tour and the congress. Undoubtedly the international features will increase the attendance at Philadelphia.

The exhibition halls at Philadelphia offer excellent facilities for the show. The exhibit hall, shown at the left in the accompanying illustration, is on the ground floor of the city's new auditorium and convention hall. The exhibit hall in the Commercial Museum building, shown at the right in the illustration, also is on the ground floor. Space on either side of the aisle in the building housing the permanent exhibits of the museum, which connects the two exhibit buildings, will be used for noncommercial and educational exhibits for the foundry industry. Splendid accommodations for technical meetings are provided in the new auditorium.

Philadelphia foundrymen are organizing to welcome the visitors at the congress and convention. The following committee chairmen have been appointed and the complete committee personnel will be announced later: General chairman, C. Walter Yost, Reading Iron Co.; Reception committee, B. H. Johnson, R. D. Wood & Co.; Plant Visitation committee, W. B. Coleman, W. B. Coleman & Co.; Hotel committee, Frank Devine, Philadelphia chamber of commerce; Transportation committee, H. L. Henszey, Carborundum Co.; Publicity committee, Thomas D. Richter, Philadelphia chamber of commerce; Ladies Reception committee, Mrs. B. H. Johnson; Golf committee, Laird U. Park, Park & Williams, Inc.; member ex-officio of all committees, Earl S. Sparks, secretary, Philadelphia Foundrymen's association.

Nonferrous Industry Presents Budget for Code

The nonferrous foundry industry proposes to collect for the expenses of formulating and putting into effect and administering the code of fair competition from July 25, 1933, to Jan. 1, 1934, totaling $5000 and the cost of code administration from Jan. 1 to June 1, 1934, totaling $19,200.

An initial assessment against each member based on his average monthly output for the first 6 months of 1933 is proposed as follows: 10,000 pounds or less, $10; 10,000 to 25,000, $25; 25,000 to 100,000, $50; 100,000 to 250,000, $75, and in excess of $250,000, $100.

An assessment for the first quarter of 1934 against each member of one-fourth of a cent per man hour for his total man hours for the months of October, November and December, 1933, no contribution to be less than $12.50, also is provided.

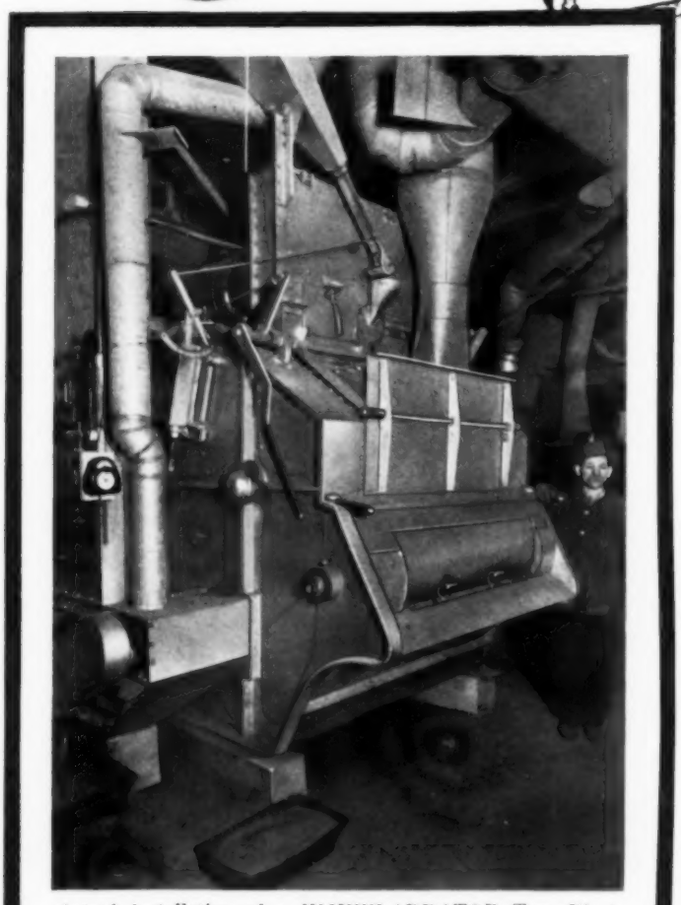
To cover the formulative period last year another one-fourth of a cent per man hour worked during July, August and September, 1933, is to be levied.

Wins Awards

Two advertisements of a series appearing recently in THE FOUNDRY were awarded honors at the thirteenth annual exhibition of the Art Directors' club in New York. These advertisements were for the Climax Molybdenum Co., New York, and won awards for art work and for layout of a complete advertisement. The advertising was prepared by N. W. Ayer & Son Inc., Philadelphia, with Alexey Brodovitch, artist, and Nelson Gruppo, art director.

Saving Wasted . . .

DOLLARS



Actual installation of a WHEELABRATOR Tum Blast

With WHEELABRATOR

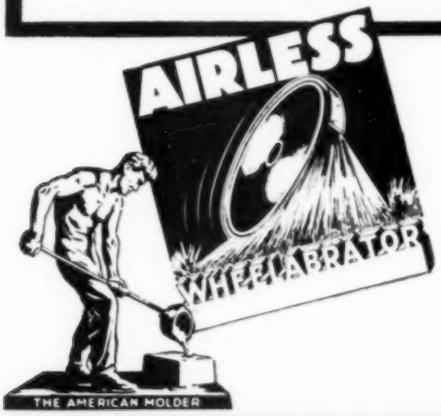
There is no method of abrasive cleaning which can approach the low cost production possible with the American Airless WHEELABRATOR. The WHEELABRATOR entirely eliminates compressed air—the most costly part of sand or shot blasting.

The American Tum Blast illustrated requires from 100 HP to 125 HP when operated with compressed air. Equipped with the Airless WHEELABRATOR not over 15 HP is required—a saving of 85 HP to 110 HP as long as the equipment is in operation.

In addition, the work is cleaned faster and better. The WHEELABRATOR is 25% to 40% more effective than sand or shot blasting. In 6 to 12 minutes, loads up to 1200 lbs. are being thoroughly cleaned.

The proof of these facts are borne out in repeat orders. One automobile company operates five WHEELABRATORS. Another uses three. A large steel and malleable foundry has purchased three units after the first installation.

You cannot afford to neglect investigating this new revolutionary method of cleaning. Complete details will be sent without the slightest obligation. Write today.



THE AMERICAN FOUNDRY EQUIPMENT COMPANY

505 BYRKIT AVENUE — MISHAWAKA, INDIANA

Steel Founders Laud NRA Effects

(*Continued from page* 19)

certain classification to a given casting, while a competitor, through misunderstanding or less laudable motive, would use a different classification and thus cut the price. The Steel Founders' society reviewed the entire schedule structure, developed standards and clearly defined and classified all cast steel products.

At the same time, the code provision permitting reporting of open prices with a waiting period prior to revision of filed prices, served to discourage precipitate cutting under buyers' pressure. No radical advance in prices resulted from this revision and standardization, coupled with open pricing, as will be noted from Table II.

This tabulation indicated that there has been an increase of only 10.2 per cent in the selling prices of steel castings since the application of the code. At the same time, due to increased wages, previously discussed, and higher cost of metals and materials, costs have increased 14.2 per cent between July , 1933 and March 1934. While the price level has advanced it has not served to cover the advance in labor and still is approximately 13 per cent lower than in 1926.

A point which is not always taken into consideration by the consumers' spokesmen and professional price busters is that steel castings and in fact all products cannot be inordinately increased in price due to the competition always present from the products of other industries.

The report concludes with an outline of its administrative procedure under which code authority membership of eight is shown to give representation to five firms definitely classified as small units. As Col. Baker affirms, the industry "wants its code and is resolved to endeavor to administer it in a way that will justify its perpetuation."

Book Review

Transactions of the American Foundrymen's Association, edited by Robert E. Kennedy, cloth, 608 pages, published by the A.F.A. and supplied to members for $2 and nonmembers for $6.

This volume contains a summary of the proceedings of the 37th annual meeting of the association held in Chicago, June, 1933; a report of the annual business meeting held during the convention; minutes of the various meetings of the boards of directors held during the year; and the by-laws of the association with revisions which were approved by the membership on Feb. 8, 1934.

The major portion of the book is devoted to the technical papers on a wide variety of foundry subjects which were presented at the annual meeting. A complete report of the oral and written discussion follows each paper. Other valuable information presented includes reports of committees and joint committees; and a symposium on tests and specifications of cast iron.

Code Authority Requests Exemptions

(*Concluded from page* 27)

by the code authority and it may be necessary to hire field men to ascertain costs in various branches and districts of the industry. He felt that while the code authority had only allocated $10,000 for that work that it would really require more at some future time.

"Up to the present time," said Mr. Halsted, "644 companies have reported total tonnage of 566,000 tons produced in 1933 representing a value of $46,000,000. Since most of the large producers already have reported we expect the balance to bring the total up to approximately 800,000 tons. The figures indicate that this total business will average about $70 per ton representing total dollar sales of approximately $56,000,000. On an annual basis two tenths of one per cent applied to fifty-six million dollars of sales will produce $112,000, approximately the amount of the budget. Following the approval of the budget and method of assessment by the administrator, we plan to make a quarterly assessment on all members of the industry at the rate of ¼ of 2/10 of 1 per cent, which will amount to 50 cents on one thousand dollars of sales."

The matter has been taken under advisement by NRA officials and questions asked by NRA representatives did not seem to be antagonistic to the changes asked by the code authority.

Discusses Sand Problems at Philadelphia

Harry W. Dietert, chief engineer, United States Radiator Corp., Detroit, spoke on "Preparing Sand for Molding" at the meeting of the Philadelphia Foundrymen's association held May 9 at the Broadwood hotel, Philadelphia. In discussing the subject, Mr. Dietert presented information on the following factors: Blending, tempering, mixing, aeration, flowability, sea coal facing, expansion of molding sand, mold depth, mold permeability and ramming.

Members of the Philadelphia association visited the Philadelphia navy yard on May 16 to inspect the foundry department.

Club Becomes Chicago Section of A. F. A.

Board of directors of the American Foundrymen's association has approved the petition of the Chicago Foundrymen's club that it be made the Chicago section, American Foundrymen's association, and charter No. 1 is to be issued shortly. At the monthly meeting of the Chicago Foundrymen's club, held May 3 at the Great Northern hotel, directors were authorized to dissolve that organization.

"Permanent Mold Castings and Special Alloy Irons for Automobile Production" provided the topic for technical discussion at the May meeting, with Fred Walls, Eaton-Erb Foundry Co., Vassar, Mich., the guest speaker. Mr. Walls described the process of casting by the permanent mold process, with details on the types of castings made and their physical properties. Further improvement in products obtained from this process is anticipated with the perfection of closer control of mold and metal temperatures. The speaker also discussed briefly the types of alloy irons now being employed in casting various automotive parts, such as crankshafts and brake linings.

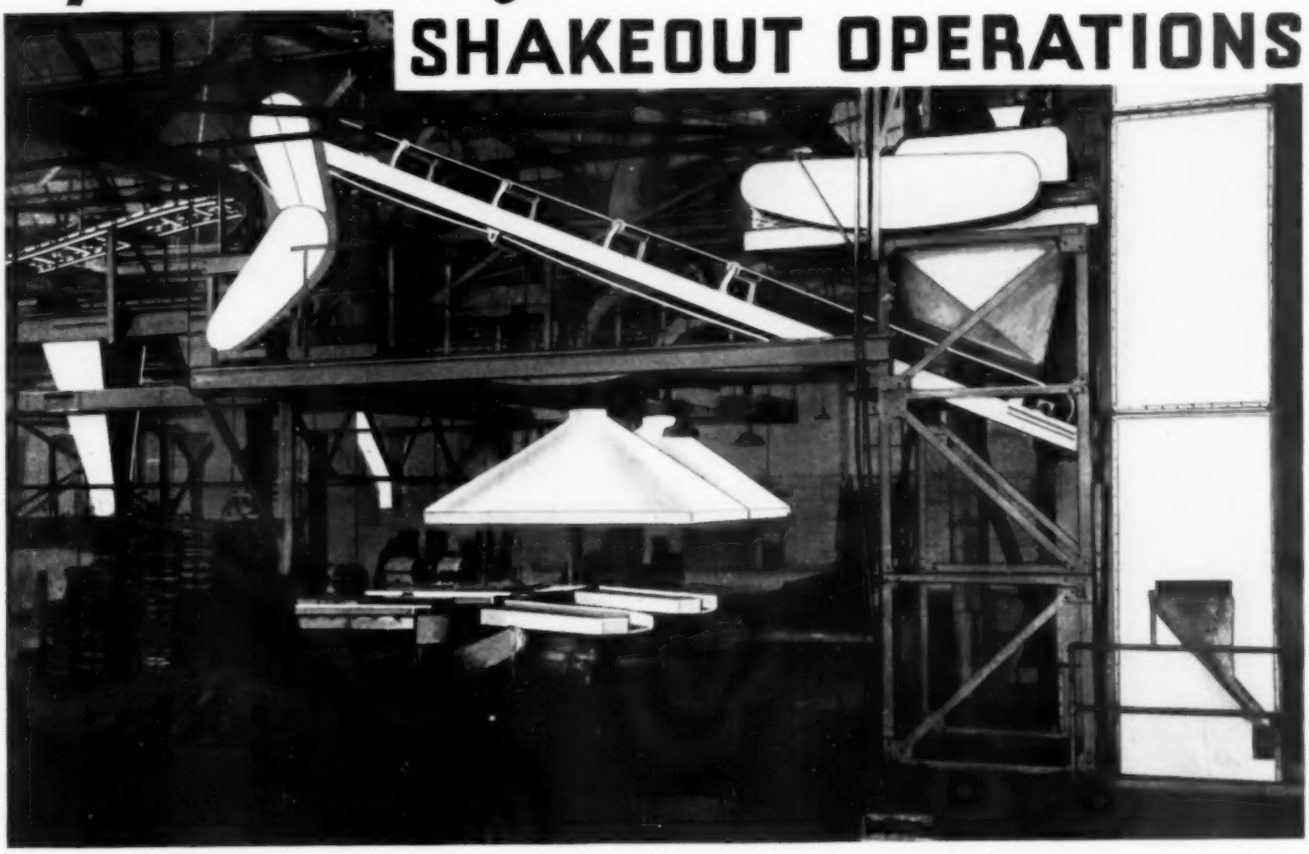
Cleveland Firm Buys Core Oil Business

The Werner G. Smith Co., Cleveland, recently acquired the core oil business, including formulas and unexpired contracts of the Spencer Kellogg & Sons Sales Corp., Buffalo. Core oils formerly produced by Spencer Kellogg now will be manufactured and sold by the Werner G. Smith Co.

Eye Protection Discussed in Bulletin

National Society for the Prevention of Blindness, Inc., 50 West Fiftieth street, New York, recently has published a bulletin on "Eye Protection in Industry" by Louis Resnick, director of industrial relations of the society. The bulletin also contains a self-appraisal form for safety engineers and other executives concerned wieh the conservation of vision in industry. The bulletin may be secured from the society for five cents.

GOOD HOUSEKEEPING
provides for CENTRALIZED SHAKEOUT OPERATIONS



Link-Belt Conveyors Make For An Orderly Plant Arrangement

Isolation of the shakeout operation can be easily and simply arranged for, through the use of Link-Belt conveyors for molds, castings, etc. Each plant presents an individual problem in this respect. Often relocation or rearrangement will accomplish much in the matter of "good housekeeping", and Link-Belt engineers are ready to offer their experience to those interested in improving foundry conditions.

LINK-BELT COMPANY

CHICAGO PHILADELPHIA INDIANAPOLIS TORONTO

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LINK-BELT

Duplexing Malleable Cast Iron

(*Continued from page* 26)

unsuccessful attempts have been made to operate with a slag while duplexing. It was felt that a better carbon control could be obtained, also the energy and electrode consumption would be somewhat lower due to the lesser amount of steel added.

When duplexing 25 tons per hour per furnace the rate of input is very high, about 5000 kilowatts, while cold melting 4 tons per hour, the input is only about 2800 kilowatts. When duplexing with a slag the heat is not transferred to the iron rapidly enough, resulting in fused side walls. Moreover, it is very difficult to maintain a slag of the correct analysis and thickness. When cold melting, which is a batching process, this is not so difficult.

Samples of cupola iron are analyzed every 20 minutes and electric furnace iron every 2 hours. All raw materials are checked periodically for uniformity. Research is conducted from time to time on certain phases of the process that require it. Control of electric furnace iron temperature is obtained by the use of optical pyrometers. Two of these instruments are on hand at all times. A third or master is kept in the laboratory for checking the service instruments to insure their accuracy. Every tap is read and the temperature is held as close to 2850 degrees as possible.

Consumption Varies With Production

Energy consumption on the furnaces runs about 48-55 kilowatt-hours per ton of iron on a 25-ton per hour production rate per furnace. Consumption varies with the production, going down with a high production rate and up with a low production rate. Iron from the cupola is hotter with high production as it does not remain in the forehearths as long as it would with low production.

Pouring temperature has a marked effect upon the energy consumption. While the heat content of the iron at several temperatures above the melting point forms almost a straight line when plotted, the kilowatt-hour consumption goes up out of proportion to the increase in heat content due to the fact that the radiation losses increase as the difference in the fourth power of the absolute temperatures. For that reason it is vital from a standpoint of economical operation to tap the furnaces at as low a temperature as is possible without producing scrap in the foundry.

It is also economical to obtain iron from the cupola as hot as possible as it reduces the amount of superheat necessary, thus reducing the kilowatt-hour consumption. Certain types of coke produce hotter iron than others, and it sometimes is economical to use a coke which gives a low cupola efficiency, but produces hotter iron, as the extra coke used is cheaper than electric energy.

Superheating the iron to rather high temperature (2950 to 3000 degrees Fahr.) decreases the time necessary for annealing. However, the additional cost for doing so, due to the increased energy consumption, higher demand, and lesser life of the refractories is entirely out of proportion to the savings. Use of covered and insulated ladles for handling the iron permits the tapping temperature from the furnaces to be lowered considerably over what it would be with open ladles which are not insulated.

Insulating the electric furnace up to the present time has not proved very successful for the following reasons. At present, the only inexpensive refractory capable of withstanding temperature of 3000 degrees is silica brick. With normal operation, this material is near the melting point at all times. If insulation is placed on the outside of the furnace, the temperature on the inner face of the brick will rise, and the brick will fuse away until equilibrium has been reached where the flow of heat through the walls is such that the brick is below the fusion point. This condition is the same as it was before insulating, with the exception that the furnace structure has been weakened, and as result no good has been accomplished. If instead of silica brick, a refractory could be used which has a considerably higher melting point, the insulation could be put on. Temperature on the inner face of the brick would rise, but the brick would not fuse and heat would be saved. However, such refractories are exceedingly expensive.

With a 50 kilowatt-hour consumption the heat distribution is somewhat as follows: 14 kilowatt-hours are used to melt and superheat the steel; 24 kilowatt-hours are used to superheat the iron. The balance is lost through radiation, conduction convection, electrical losses, etc. A furnace efficiency of about 80 per cent is obtained. The power factor on the furnaces is about 75 per cent. This power factor together with the plant load factor is corrected by a 3500 kilovolt-ampere synchronous condenser, the corrected overall factor being about 92-93 per cent.

Electrode Consumption Varies

Electrode consumption runs between three and four pounds per ton of iron on a 25-ton an hour production per furnace. The consumption will vary with the kilowatt-hour consumption, there being almost a direct relationship. Current density has a decided effect on the electrode consumption, high current densities causing high electrode consumption. To keep the current density low the input is held down and firing is done over as long periods as possible. With high current densities, the electrodes must be kept close to the iron where there is more chance of solution in the iron than there would be if they were carried higher.

Life of the electric furnace refractories is influenced to a great extent by operation of the furnace. High inputs tend to destroy the refractory. As previously stated, basic slag from the forehearth will flux the furnace lining and destroy it. The average life of a top is 3000 tons, the side walls 4000 tons and the bottom indefinite, bottoms being patched but not replaced.

The cupola lining at the melting zone is repaired daily; further up in the shaft about once every 2 months. Forehearths are patched once a week and relined once a month.

Iron made by the duplexing process has a tensile strength of 48,000-52,000 pounds, a yield point of 33,000-37,000 pounds and an elongation of about 15 per cent. The iron machines readily and castings made from it are exceptionally free from shrink.

Continuous Melting

THE duplexing process of melting is employed in some malleable foundries to provide metal continuously for conveyor lines and to produce metal with certain characteristics. The practices for manufacturing malleable castings outlined in this article were discussed by the author, who is assistant metallurgist, Saginaw Malleable Iron Division, General Motors Corp., Saginaw, Mich., at the recent foundry short course conducted by the mechanical engineering department of Michigan State College of Agriculture and Applied Science at East Lansing, Mich.

Lawrence K. Cecil has been appointed sales representative of the Coppus Engineering Corp., Worcester, Mass., in the Oklahoma and Texas territories, with headquarters at 1531 East Thirty-fifth street, Tulsa, Okla.

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Studies Cast Red Brass

(*Continued from page* 23)

Coupon from "immersed-crucible" ingot—This method of obtaining a test bar consists essentially in withdrawing a sample of metal by a graphite crucible submerged beneath the surface of the liquid metal, as illustrated in Fig. 6. In this method the tightly closed crucible *A*, of known volume, was immersed beneath the surface of

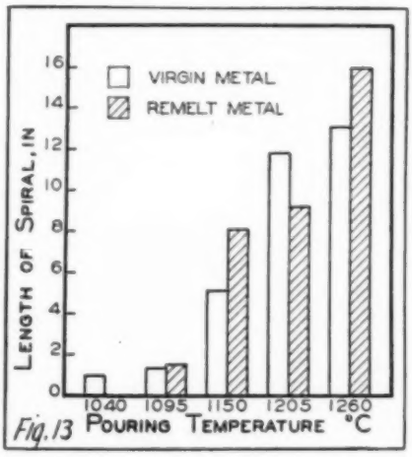


Fig. 13—Running properties of red brass cast in green sand molds

the metal. The top *E* was then raised by the rod *C* and the crucible filled. The cover then was replaced and the crucible containing the sample of metal removed, placed in a dry sand mold and allowed to cool to room temperature. The ingot was used to determine shrinkage as well as in other tests. The method permitted the sampling of any heat without contamination that may be caused by the moisture of sand molds. The gassing of metals and the possible source of such contamination are of interest to the foundry industry. The method also permitted a comparison between metal as ordinarily cast and the same metal that was not subjected to pouring and to mold conditions. Immersed-crucible samples were taken from each crucible of metal before the other forms of test bars were cast. The ingot thus obtained was used to furnish data on the shrinkage of the liquid metal, after which it was machined to a conventional test specimen.

The tensile properties were determined with an Amsler universal testing machine of 50,000-pounds capacity, the load being applied uniformly with a rate of travel of the moving head of 0.1-inch per minute. The test specimen was 0.505-inch in diameter, with threaded ends and a 2-inch gage length.

The reported results are the averages of duplicate determinations, usually on bars from the same heat. In most cases the tensile strengths of the duplicate bars agree within about 1,000 pounds per square inch (about plus or minus 3 per cent) although there were a few larger variations. In such cases the higher values were accepted as being more authentic. Observed differences of less than 1000 pounds per square inch are probably not significant.

The shrinkage of the alloy from a temperature of 1315 degrees Cent. which exceeded the highest pouring temperature used, 1260 degrees Cent., to room temperature was determined by the method described by Saeger and Ash. in the bureau of standards *Journal of Research*, Vol. 8, No. 1, 1932. It included the determination of the shrinkage (a) of the liquid metal, (b) during solidification, and (c) in the solid state.

The running properties of the alloy were studied by the method described by Saeger and Krynitsky Transaction of the A. F. A. 1931, which consists essentially in casting in a green sand mold a small spiral strip of uniform parabolic cross-section. The length of the spiral is taken as an indication of the relative flowing properties of the metal under the conditions used.

For purposes of discussion the investigation may be divided into two parts, (1) the properties of the alloy made from virgin metal and from remelted metal, and (2) the effects of

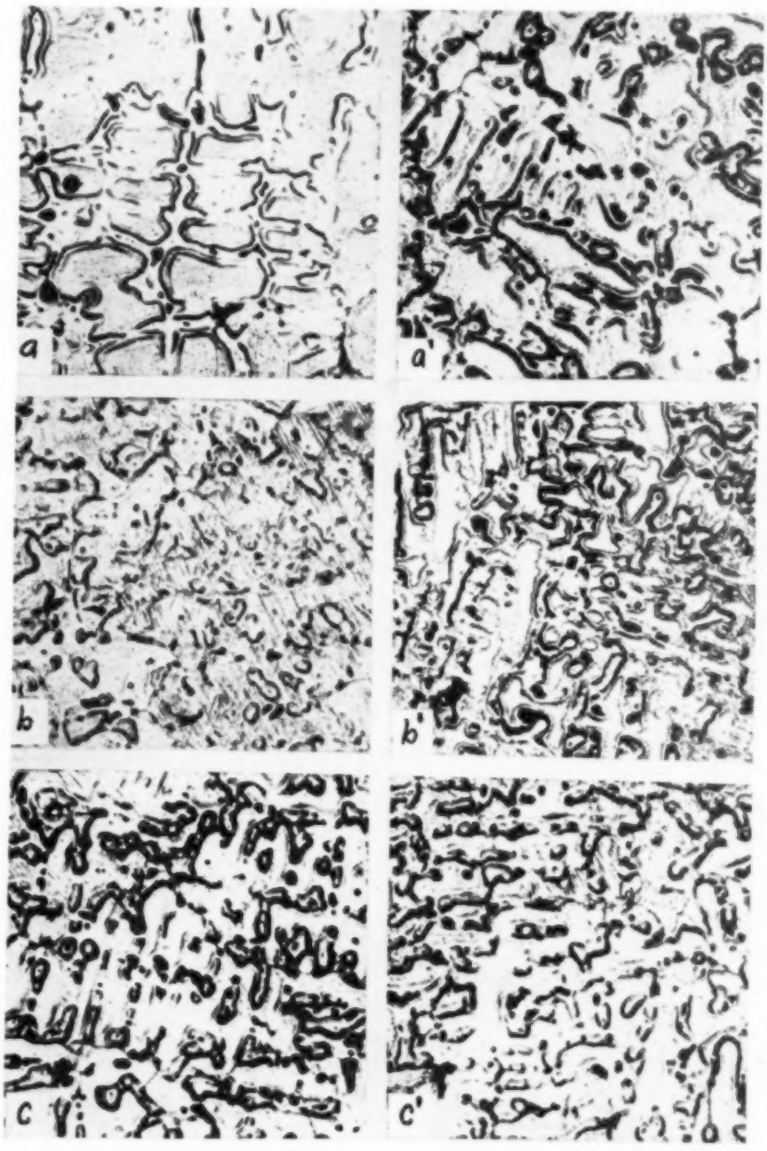


Fig. 14—Microstructure of test bars of virgin metal, x100, etched. a, ingot obtained by immersion crucible method at 1205 degrees Cent. a', same at 1260. b, end-gate bar cast in sand to size, poured at 1205. b', same at 1260. c, end-gate sand cast bar machined to size, poured at 1205. c', same at 1260

small percentages of sulphur or iron on these properties.

Data obtained for ultimate tensile strength are presented in Fig. 8. For each type of test bar, maximum tensile strengths were obtained at pouring temperatures of 1095 and 1150 degrees Cent. A marked drop in tensile strength was observed for the machined sand-cast specimens poured at 1260 degrees Cent. No pronounced beneficial *skin effect* on cast-to-size specimens was observed except for bars cast at 1260 degrees Cent.

On the basis of tensile strength, the various types of test specimens may be arranged in three groups. The highest tensile strength was obtained on specimens cut from the chill-cast ingots. Next in order were those cut from the ingots made by the immersed-crucible method. The sand-cast bars, except those cast to size, were uniformly lower in tensile strength. No significant differences were noted between the virgin and the remelted metal in the same form of test bar.

Brinell hardness determinations were made on one of two parallel flat faces, ⅝-inch in width, machined on the sides of the threaded portions of the broken test specimen. Each result shown in Fig. 9 is the average of three determinations. The results for brinell hardness show the same general trend as do the corresponding values for tensile strength.

The determination of electrical resistivity was made on the specimens used subsequently for tensile tests. These determination[6] were made by Dr. J. L. Thomas, associate physicist, bureau of standards according to the procedure recommended by the American Society for Testing Materials. The results, presented graphically in Fig. 10 show that the specimens having superior tensile strength and hardness invariably had lower resistivities. The resistivity increased decidedly as the pouring temperature was increased above 1150 degrees Cent. This change in resistivity was more uniform for the remelted metal than for the virgin metal.

Density was determined on the ends of the broken tensile test specimens by the conventional method of displacement of water. The results are given in Fig. 11. No marked differences in density between the virgin metal and the remelted metal were found. All of the sand-cast bars showed a decided decrease in density as the pouring temperature was increased. The densities of specimens from the chilled ingots which were uniformly higher than those of the sand-cast bars, were independent of pouring temperature. The density of specimens obtained by the immersed-crucible method for pouring temperatures of 1205 degrees Cent. and above, was intermediate between the corresponding values for the chilled ingot and the sand-cast bars. The maximum density was obtained in practically all cases with a pouring temperature of 1095 degrees Cent.

The shrinkage of the liquid metal (*E-D*, Fig. 7) expressed in terms of the changes in specific volume was determined by the immersed-crucible method. Data on the shrinkage of the solid metal (*C-A*, Fig. 7) were obtained by direct observations of the change in length with change in temperature of a special sand-cast rectangular bar. To determine the shrinkage during solidification (*D-C*, Fig. 7), it was necessary to determine the solidus, *C*, and the liquidus, *D*, for this alloy. By thermal analysis, an average value of 840 degrees Cent. was obtained for the liquidus and of 1000

(*Concluded on page 52*)

Exchange Paper

RESULTS of an investigation sponsored by the Non-Ferrous Ingot Metal institute at the bureau of standards to collect data to be used in the simplification of the number of compositions of copper-base ingot metals are presented in this article. The second phase of the work, in which the separate effects of sulphur and iron were studied, will be presented in an early issue. The articles are from the annual exchange paper of the American Foundrymen's association to the Institute of British Foundrymen. The author is physicist, United States bureau of standards, Washington.

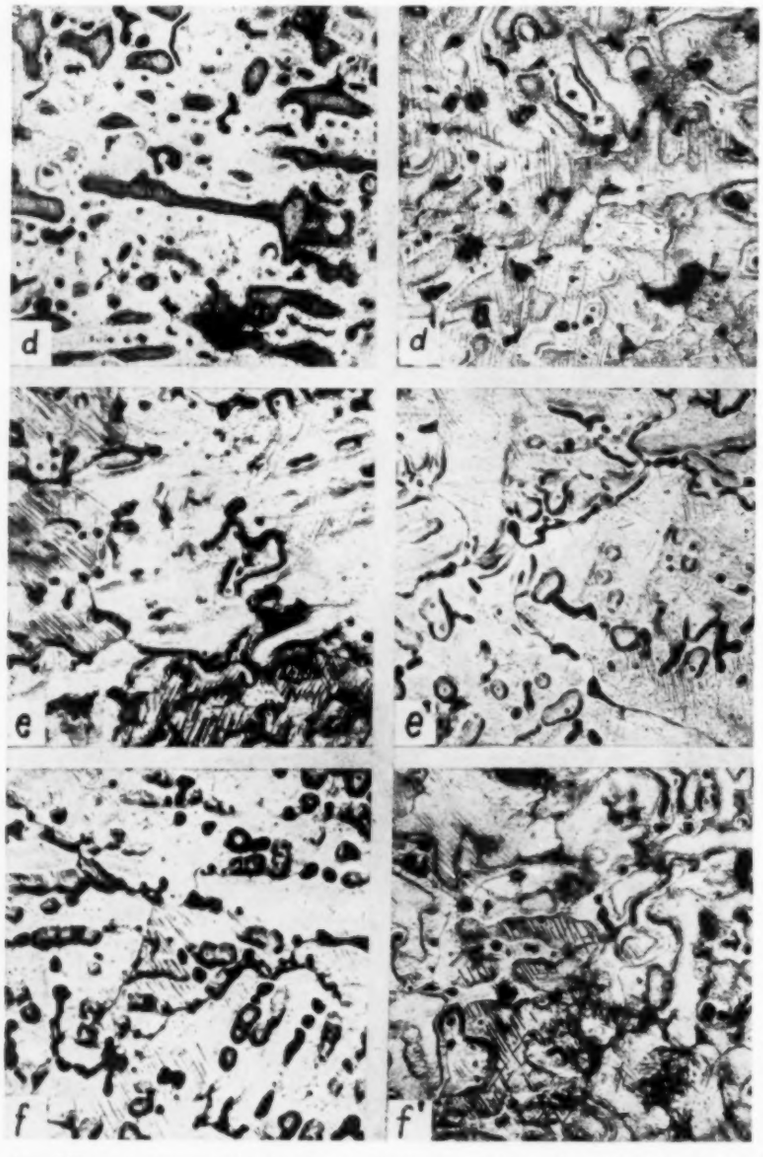
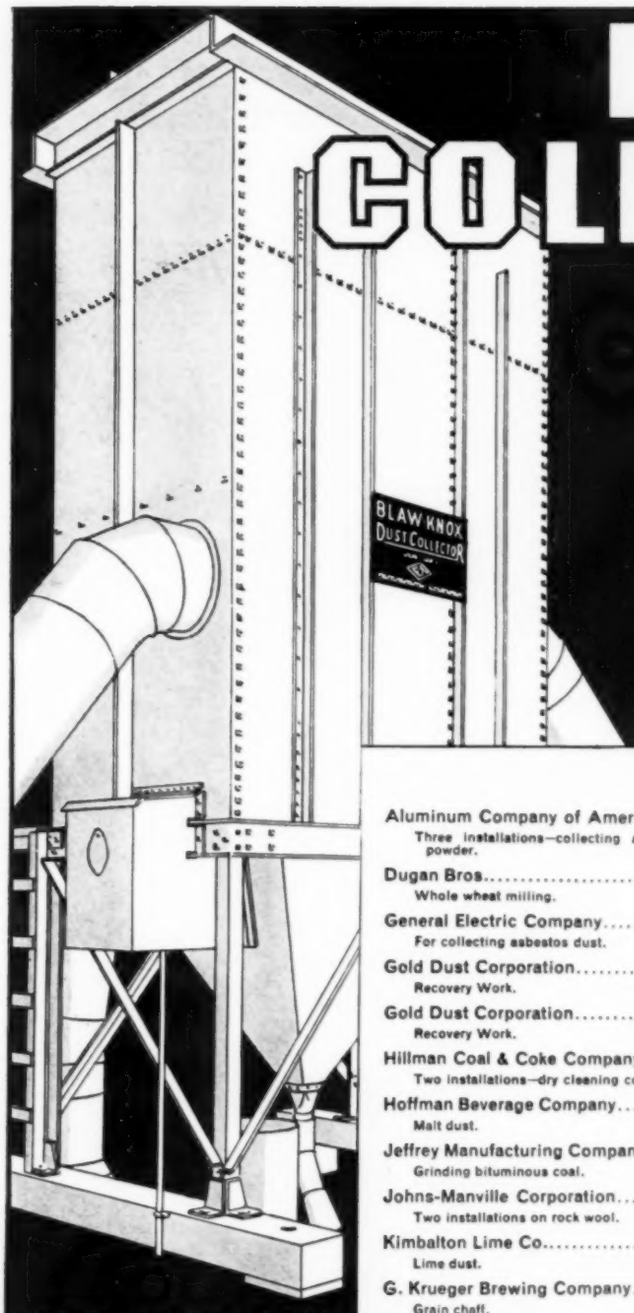


Fig. 15—Microstructure of test bars of virgin metal, x100, etched. d, fin-gate sand cast bar, ⅛-inch web, poured at 1205. d', same at 1260. e, fin-gate sand cast bar, 3/16-inch web, poured at 1205. e', same at 1260. f, fin-gate sand cast bar, ¼-inch web, poured at 1205. f', same at 1260

DUST COLLECTORS



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Muskegon Piston Ring Co.....Muskegon, Mich.
Grinder dust.

National Tube Company.....Ellwood City, Pa.
For grinding and sanding machines.

Norfolk Navy Yard.....Portsmouth, Va.
Foundry shakeout.

Perfect Circle Company.....Hagerstown, Ind.
Grinding piston rings.

Perfect Circle Company.....Tipton, Ind.
Grinder dust.

Peter Cailler-Kohler Swiss Chocolate Co., Inc.....Fulton, N. Y.
Handling Cocoa dust.

Philadelphia & Reading Coal & Iron Co., Philadelphia, Pa.
(St. Nicholas Breaker) Two installations—handling anthracite coal.

Picone Brothers Asphalt Plant.....Brooklyn, N. Y.
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Ralston-Purina Co.....Lafayette, Ind.
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Raybestos-Manhattan.....Passaic, N. J.
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Richmond Brewing Company.....Richmond, Ind.
Malt dust.

Sonoco Products Company.....Hartsville, S. C.
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(*Concluded from page* 50)

degrees Cent. for the solidus. The difference between the specific volumes corresponding to these two temperatures is designated as the shrinkage of solidification. No significant differences in shrinkage were observed between alloys made from virgin metal and from remelted metal.

However, there was observed, in the determination of the linear shrinkage of the solid metal, a definite expansion at a temperature just below the solidus. This is shown in Fig. 7 by the portion of the curve *H-B*. To determine whether or not this expansion was the result of *gassing* of the metal from the charcoal which formed a part of the protecting covering used in the ordinary procedure, charges were melted in the induction furnace, and in a gas-fired furnace with a protective covering of fused sodium carbonate. The same phenomenon was observed in all cases, for remelted metal as well as for virgin metal. These results are given in Fig. 12. The cause and significance of this behavior are still uncertain.

The running properties were determined on both virgin and remelted metal, with the results shown in Fig. 13. The remelted metal, cast in green sand, was more fluid than virgin metal cast under the same condition.

In an endeavor to explain the reason for the pronounced influence of the pouring temperature on the physical properties of sand-cast bars and specimens obtained by the immersed-crucible method, the macrostructure of bars cast at 1205 and 1260 degrees Cent. was studied. Macrographs of etched medial longitudinal sections perpendicular to the parting line of the mold are shown in Fig. 4 and 5. In Figs. 4 and 5, *a* shows the ingot obtained by immersed-crucible method; *b* end-gate sand cast bar- cast to size; *c* end-gate sand cast bar, machined to size; *d* fin-gate bar $\frac{1}{8}$-inch web; *e* fin-gate bar 3/16-inch web; *f* fin-gate bar $\frac{1}{4}$-inch web. The tendency for the formation of a columnar crystalline structure in the bars cast at the higher temperatures was much more pronounced than in the corresponding bars poured at the lower temperatures. A comparison of these results with those previously given indicates that a marked columnar structure is accompanied by inferior physical properties.

Little difference in structure was found in the two types of sand-cast bars that were cast to size. In both, the columnar structure predominated. In the larger specimens of this type, machined to size, the difference in structure caused by the pouring temperatures was more pronounced. In all of the fin-gate sand-cast bars, a marked nonuniformity of structure across the section of the bar existed. The portion of the bar formed in the drag of the mold had a pronounced columnar structure, whereas the remainder, which was undoubtedly influenced by the relatively large mass of metal in the attached riser, had an equiaxed crystalline structure. Such a marked nonuniformity of structure across the section of a test bar is not desirable and should be avoided.

The observed difference in physical properties of bars obtained by the immersed-crucible method at 1205 and 1260 degrees Cent. is believed to be due largely to the difference in grain size.

The effect of pouring temperature on the microstructure of the various test bars is shown in Figs. 14 and 15. In each case the micrograph shows a representative area in the reduced section of the bar just within the inner surface layer of the columnar crystals. Markings were found within the individual grains of all the sand-cast specimens, consisting of groups of parallel lines which were considered the result of deformation or strain during cooling. This structural feature was not found in the bars obtained by the immersed-crucible method. This fact indicates that no strains are set up in the latter bars on cooling, such as exist in the sand-cast bars when the gates and risers are in a fixed position within the sand mold. These apparently cause permanent straining of the bar by shrinkage during cooling, while the metal is in a very *tender* condition immediately after solidification.

This is the first of two articles dealing with the investigation of cast red brass. The second and concluding section will be presented in an early issue.—THE EDITORS.

Malleable Group Elects Twelve Directors

Malleable Founders' society recently elected directors for the fiscal year beginning June 1. Directors of the society, under the code of fair competition for the malleable industry, also constitute the code authority. Directors are as follows:

WESTERN SECTION: R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; E. E. Griest, Chicago Railway Equipment Co., Chicago; F. S. O'Neil, Link-Belt Co., Indianapolis; and Brinton Welser, Chain Belt Co., Milwaukee.

CENTRAL SECTION: R. N. Cole, Canton Malleable Iron Co., Canton, O.; C. C. Gibbs, National Malleable & Steel Castings Co., Cleveland; John C. Haswell, Dayton Malleable Iron Co., Dayton, O.; and A. F. Jackson, Michigan Malleable Iron Co., Detroit.

EASTERN SECTION: C. L. Berger, Eastern Malleable Iron Co., Naugatuck, Conn.; F. O. Parker, Acme Steel & Malleable Iron works, Buffalo; H. L. Steeves, Rhode Island Malleable Iron works, Hillsgrove, R. I.; and P. R. Van Duyne, Meeker Foundry Co., Newark, N. J.

Museum To Have Foundry Exhibit

(*Concluded from page* 24)

ton framework around which the branches will be grouped, various melting units as folows: Cupola, electric furnace, crucible etc. Next in line will be shown a molding floor with a pattern, probably a toothed gear, being molded, a typical molding machine for that particular sort of casting, a casting in the rough of each material, cast iron, malleable, steel, brass and aluminum, cleaned castings and finally machined casting. This series naturally groups itself under the following heads—melting, molding, coremaking, pouring finishing and machining. Around each of these steps in the evolution of a casting will be grouped appropriate exhibits of all the materials used, pig iron and scrap, fluxes and refractories, sands and binders, cleaning room and annealing supplies etc. Some of these exhibits will be pictorial displays.

There will be appropriate murals and to those who desire more detailed and technical information there will be provided the complete literature of the art, printed on metal tablets for permanence and ready access. The attendants in charge of the exhibit will be experienced foundrymen, or at least men sufficiently experienced to be able to explain intelligently to school children and others each step of the art and to even instruct in the more elementary branches.

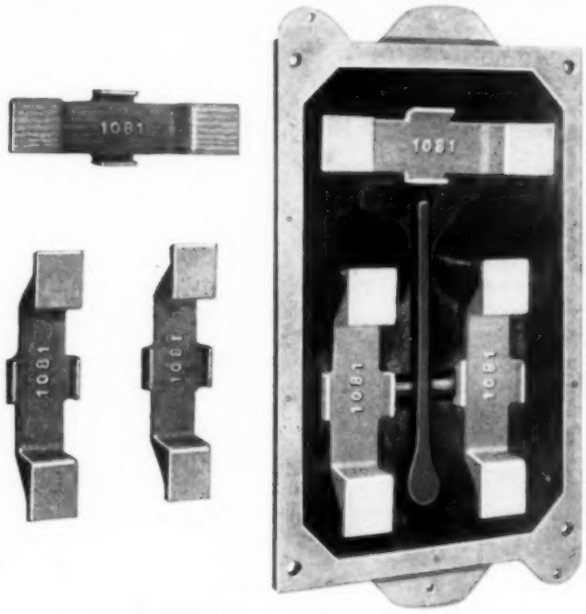
The committee especially desires to make the exhibit so attractive and stimulating to the youthful mind that some may thereby be led to adopt founding as a trade and thus begin that process of building for the future of the industry.

Handles Refractories

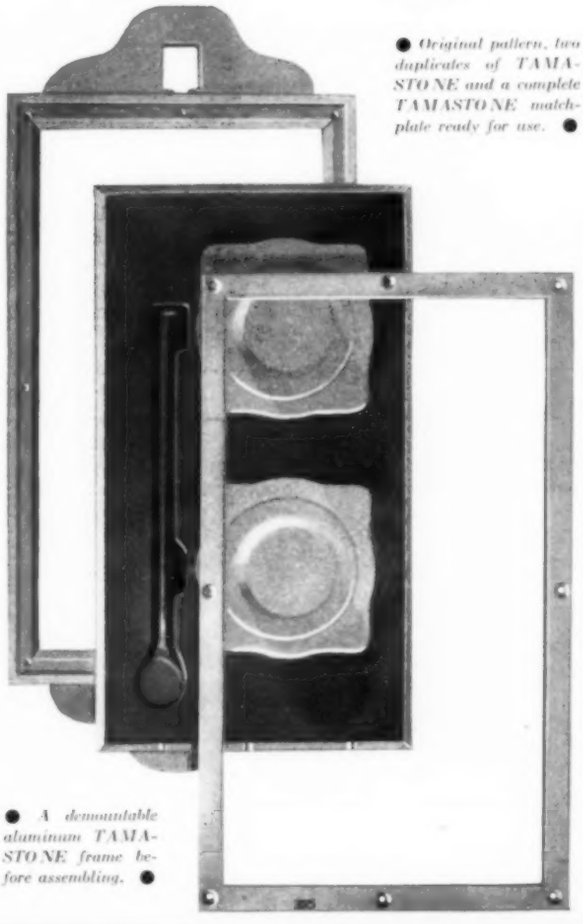
Glencoy Specialties Co., Zanesville, O., has been appointed special representative of the Ironton Fire Brick Co., Ironton, O., in Eastern Ohio, Western Pennsylvania and part of West Virginia. Personnel of the Glencoy company consists of William McCoy, H. F. Crew and W. M. Hughes.

G. E. Alderson, for the past 13 years assistant general superintendent and metallurgical engineer, Federated Metals Corp., Duquesne Reduction branch, Pittsburgh, now is affiliated with Rochester Smelting & Refining Co. Inc., Rochester, N. Y.

TAMASTONE



● *Original pattern, two duplicates of TAMASTONE and a complete TAMASTONE matchplate ready for use.* ●



● *A demountable aluminum TAMASTONE frame before assembling.* ●

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They also serve who sit and read

The Adventures of Bill

BY PAT DWYER

WHILE discussing the details of a proposed cruise on the lakes this coming summer Bill pulled a document from his pocket and said he should like to have my rede, my opinion, my reaction to a tentative code he had prepared on behalf of owners, part owners and would-be owners of pleasure craft.

"This is addressed," he said, "to Hon. Franklin Delano Roosevelt, Yacht Amberjack, Somewhere between the Potomac and Passamaquoddy, At Sea.

Ahoy! Shipmate: Whereas practically every industrial and commercial group has or have received invitations to present a code covering—"

"Avast heaving! Your running gear is all in snarl. Listen—

"I know what you mean. However, you must admit that the salutation 'Ahoy! Shipmate,' is the pure quill, the real thing. Bound to establish a bond of understanding and insure a sympathetic and speedy hearing. One old salt to another, you know. Deep calling unto deep. Hands across the sea, and all that kind of thing. See what I mean?"

"Your idea won't take you to first base. Not even to the first can buoy in the channel. The proposition shows that you possess a certain degree of low animal cunning, but so far as obtaining your objective is concernel, you might just as well whistle up the galley stove pipe, or attempt to moor your boat in a heavy tide rip with a single strand of spun yarn.

"These codes are not submitted to the President. He has troubles enough of his own lining his stable of spirited trotters and pacers up before the starting barrier. Some of these beetles—to drop into the vernacular of the track—are right fractious, bull headed and hard to manage.

Codes are placed before a hard-boiled ci-devant military gent yclept Gen. Hugh S. Johnson, who has full power to administer the high justice, the middle and the low.

"Under the high justice your code is tossed out through the front door with instructions for revision. Under the middle justice *you* are tossed out through the back door with a yellow tin can tied to your tail. Under the low justice you are ear-marked, branded and banished to the salt mines of Siberia for six terms of 48 years each, to run continuously.

"The general idea of this low justice ruling, as nearly as I can understand, is to give the administration a reasonable period in which to try out the National Industrial Recovery act. Obnoxious code makers may return after they have served their terms in the mines. If all is quiet along the Potomac and if conditions have not changed to any material extent during their absence, they may invoke their constitutional rights and appeal their cases—and a fat lot of good that will do them."

"You're telling me?" quoth Bill with markedly rising inflection and with heavy accent on the *me*. "You're telling me about the high justice, the middle and the low?"

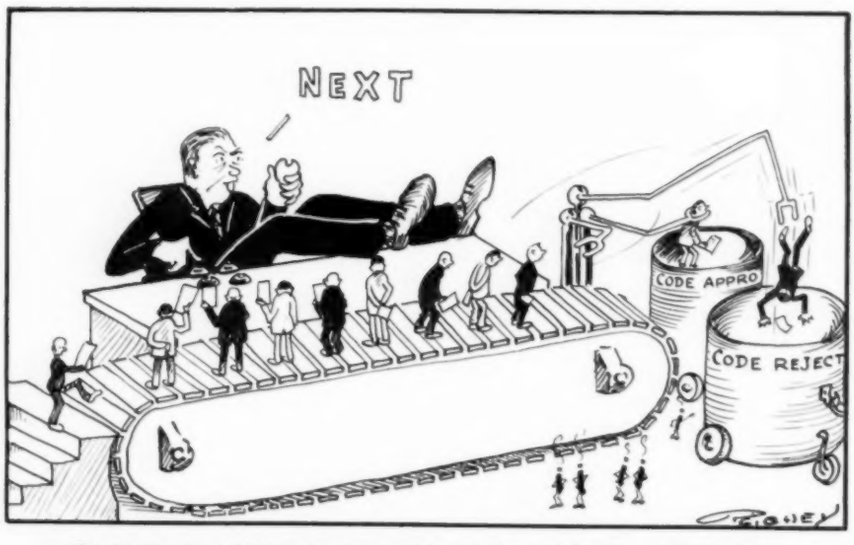
A comprehensive shrug of the shoulders and a scornfully out-thrust chin and lower lip intimated quite plainly, "God help all poor sailors on a night like this."

"Not content with this shocking fohpaw—boner to you—you magnanimously tender the information that Gen. Hugh Johnson is the guy with the big brass cannon, the official starter in this here now code race. Again I repeat, you're telling me?

"Listen, you poor swab. Gen. Johnson is an ARMY man from the top of his head to the last shining rowel point on his jingling spurs. The first thing an army man acquires after a uniform and a short hair cut is a profound and decided aversion to the navy and to everything connected with acquatic activities.

"Do you know what would happen if I were to submit this priceless code direct to the Gen? I'll tell you what would happen. The Gen would call in the third assistant to the fourth assistant secretary and say: 'Here, boy, file this thing away in the bottom of the lost and found box, back of the whatnot in the attic. If it is never found, it will be too soon, and the world will be a better place in which to live.

(*Concluded on page* 57)



He don't plant taters, he don't plant cotton, jes' keeps rollin' along

(*Concluded from page* 54)

Allieoup!' sez the Gen. to you.

"Contrast this scaly reception with that acorded my code submitted first to the President. He saunters into the Gen's den one fine morning and say: 'Mornin', Hughie, old blood and bones. How're they comin'? Fine! Say, here's a little thing—ahem—a very commendable document from one of my old bosom friends on the rolling deep. Member of one of our best known families which traces its decent in an unbroken line from Gar Wood back to Noah. I—er—trust it—the document of course—ha, ha—meets with your approval.'

"The Gen throws a casual and perfunctory glance over the first sheet, 'O. K., Chief,' says he heartily. 'Glad to be of service any time.' He affixes his signature with one hand, applies the official stamp with the other, blows a compressed air whistle with his foot for an orderly to toss the sheet on a conveyor carrying the out-going mail. And there y'are!"

"You win," I said. "Consider all former objections withdrawn. However, I should suggest a change in the spelling of one word in the address."

"Oh, yeah? And pray what word is that?"

"The word *hon*."

"What's wrong with hon, and how would you change it?"

"Replying in reverse order to the queries of my learned nautical friend, I should spell the word out in full H-o-n-o-r-a-b-l-e. As it stands, the word has a cheap and semi-vulgar connotation."

"Objection sustained—hon. Now that you direct the subject to my attention I must confess to a feeling of nausea on sundry and divers occasions when I have been forced to listen to a couple of mountains of pulp and avordupois interlarding their conversation with hons. Hon is out. Anything else for the good and welfare of the order before proceeding with the reading of the code?"

"Cut out the hon, the monkey spelling and the ahoy shipmate. None of that stuff is necessary. Simply address it to the President. He'll get it. He is fairly well known—now. Better still, throw it away and talk about something with which you are familiar. Any peculiar problems in the foundry recently?"

"Well," said Bill, "I'll tell you. Now that you bring that up, I heard of one recently. Every foundryman has troubles of his own at one time or another, but I think the brass foundryman has more than his share. I realize that this point is open to dispute and that men whose activities have been confined almost or entirely to what the boys in the shop refer to 'one branch of the trade' will rise up to point out that they are the real martyrs. As an impartial observer and one who has felt the thorns in many branches I still think the brass foundryman would stand the best chance for acceptance if a candidate were required to play the part of that old veteran hard luck actor, Job."

"Outside some knowledge of broken pots," I pointed out, "I fail to see any parallel between the experience of a brass foundryman and that of the

Hon.: Probably dim., honey dew melon

gent who established an all time record for patience under extreme provocation. Are you sure you have not two other lads from Pittsburgh in mind?"

"To expedite matters," Bill said, "which is just another way of saying to save myself from any more of your silly chat, I'll simply outline a certain recent case in which a thorn in the side of a down East foundryman caused him a great deal of aggravation.

"Blemishes in the form of streaks and small pits showed upon his brass castings after they were highly polished and rendered them unfit for chromium plating. He forwarded a sample of polished casting for examination and stated that the defects instead of disappearing are rather accentuated by the plating. The metal is an alloy containing copper 90 per cent, tin 6 per cent, zinc 2 per cent and lead 2 per cent. Results were alike whether the metal was prepared on the premises from all new stock, or secured in ingot form from reputable smelters. He has tried green sand, skin dried and French sand molds. He has tried over the lip and bottom pouring. The metal is melted in No. 50 graphite crucibles in a pit fire using coke or hard coal. The melting time is about 3½ hours.

"This type of blemish is a fairly common source of trouble in red brass castings where the surface is polished. Also it is one of these annoying little problems, apparently simple, which involves a considerable amount of study and experiment before it is finally solved. The somewhat plausible assumption that the sand might be responsible is disproved by the results of pouring the castings in skin dried and French sand molds. Manifestly the first point at which to start an investigation is by identifying the foreign material in the affected areas. This naturally starts an investigation leading to the possible source of this material. With these two points established the foundryman can turn his attention to the development of a method to prevent (a) the formation of material or (b) its entrance into the mold.

"Sand inclusions readily may be identified either by the naked eye, or through a glass with comparatively low magnifying power. Where sand appears in the casting the obvious remedy is to exercise greater care in the preparation of the sand and in the formation of the sprue, runner and gates.

"In the present instance an analysis by two distinct methods of identification shows that the substance in the specks and streaks is an iron salt, probably iron sulphide. This salt melts at 2200 degrees Fahr., the pouring temperature of the molten brass and since it is of a lower specific gravity, it floats on top of the metal, like globules of oil on water. Below 2200 degrees Fahr., the sulphide becomes a brittle solid which breaks into small particles. These particles lodge in or under the skin of the casting where the polishing process reveals them as streaks or pits.

"The material is a result of the combination of iron and sulphur. The iron comes from pokers or stirrers and the sulphur comes from the coke. Where the metal is melted rapidly the chances for the formation of this material are reduced. In the present instance the melting time, 3½ hours is too slow for a No. 50 pot. The stack either is too small or too low.

"Iron stirrers or skimmers should not be employed on this metal. Where the sulphide is present it will be found at or near the top of the pot. Therefore as a precautionary measure it is advisable to pour the first metal into unimportant castings and the remainder into the castings that are to be polished. In addition to the usual charcoal, a small quantity of glass will protect the metal at the top of the pot from coming into contact with the furnace gas consisting largely of sulphur dioxide.

Total number of employes of federal, state and local governments increased from 2,618,000 in 1922 to 3,122,000 in 1932, of 19.3 per cent, according to an analysis of the National Industrial Conference board. The figures do not include recipients of any form of relief. During the same period the total population of the country increased 13.6 per cent.

Burgston Heads Quad-City Association

Clyde H. Burgston, metallurgist, Deere & Co., Moline, Ill., was elected president of the Quad-City Foundrymen's association at the annual meeting held in Rock Island, Ill., May 21. Other officers are as follows: Vice president, T. J. Frank, Frank Foundries Corp., Davenport, Iowa; secretary-treasurer, J. Morgan Johnson, Tri-City Manufacturer's association, Moline; directors, P. T. Bancroft, John Deere Harvester Works, East Moline, Ill., H. Bornstein, Deere & Co., Moline, A. E. Hageboeck, Frank Foundries Corp., Moline, R. L. Eichman, Bettendorf Co., Bettendorf, Iowa, F. W. Kirby, John Deere Spreader Works, East Moline, J. H. Ploehn, French & Hecht, Inc., Davenport, M. J. Gregory, Caterpillar Tractor Co., Peoria, Ill., C. F. Scherer, Davenport Machine & Foundry Co., Davenport, and Harry F. Henninger, International Harvester Co., Rock Island, Ill.

Don J. Reese, Whiting Corp., Harvey, Ill., spoke on "Cupolas, Their Construction, Design and Control." Mr. Reese commented on the improvements which have been made in design, discussed the various parts of the cupola and the functions of each part, and indicated the best practice in operating that type of melting unit.

The next meeting of the organization will be held in September.

Book Review

National Metals Handbook, 1933, fabricoid, 1453 pages 4¼ x 7 inches, published by the American Society for Steel Treating, Cleveland, and supplied by THE FOUNDRY, Cleveland, for $10 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., London.

This edition, of the handbook which is published in revised and enlarged form every two or three years, contains a wide variety of information covering practices and principles in six ferrous and nonferrous metalworking industries. It is pointed out that the material has been prepared by recognized authorities on the various subjects who have obtained their material from sources which they consider trustworthy and reliable.

The first portion of the work is devoted to a presentation of general data, and to general discussions of testing and heat treatment. This is followed by information on grinding wheels; mechanical methods of cleaning metals; various processes, methods and equipment employed in numerous operations; and trade names, definitions and weights.

In the ferrous section, the discussion relates to the constitution of ferrous alloys, properties of iron and iron alloys, methods of testing, melting, mechanical working, heat treatment, welding, surface treatments and applications. The nonferrous section provides information on a wide variety of metals and alloys, including aluminum, copper, lead magnesium, nickel, tin, and zinc. An extensive index is provided.

Firm Celebrates Fifteenth Anniversary

The Milwaukee Chaplet & Mfg. Co., Milwaukee, recently celebrated its fifteenth anniversary with an open house. Door prizes were given to the following: First, Fred Voelkel, Federal Malleable Co., West Allis, Wis.; second, H. P. Kreulen, Spring City Foundry Co., Waukesha, Wis.; third, J. E. Eppley, Badger Foundry Co., Racine, Wis.; fourth, Jack Shotola, Maynard Electric Steel Casting Co., Milwaukee. Paul F. Rice is president of the company.

Made Administration Member of Code

George Pilling, Philadelphia, recently was appointed administration member to the code authority of the refractories industry by the National Recovery administration. Mr. Pilling was manager of brass foundries for the Northern Iron Co., Fort Henry, N. Y., from 1914 to 1920. Later he was eastern manager for the Freyn Engineering Co., Chicago, and from 1923 to 1931 was secretary and treasurer of Pilling & Co. Inc., Philadelphia.

Appointed Member Of Die Casting Code

William D. Ward, New York, has been appointed administration member of the die casting manufacturing industry code authority. Mr. Ward was connected with the Pelton Water Wheel Co., San Francisco, from 1900 to 1922. He was a departmental head for a number of years and in 1919 was appointed manager of that company's Atlantic department with headquarters in New York. In 1922 the Pelton company was sold to William Cramp & Sons Ship & Engine Building Co., Philadelphia, and Mr. Ward continued his departmental activities under the new ownership in addition to being general sales manager of the Cramp company and its subsidiaries, on the sale of all products except shipwork. He retained that position until January, 1932 and since that time has been associated with Carroll S. Smith, consuling engineer, 33 Rector street, New York.

Davis Made President of Pittsburgh Founders

C. E. Davis, Homestead Valve Mfg. Co., Coraopolis, Pa., was elected president of the Pittsburgh Foundrymen's association at the May meeting of the group held in the auditorium of the Pittsburgh chamber of commerce, Smithfield and Seventh avenues, Pittsburgh, on May 21. A. M. Ondreyco, Westinghouse Air Brake Co., Wilmerding, Pa., was elected vice president, and C. H. Paul, Mackintosh-Hemphill Co., was reelected secretary and treasurer. The executive committee consists of the following: F. C. T. Daniels, Mackintosh-Hemphill Co.; H. P. Spilker, Sterrit Thomas Foundry Co.; S. W. Cuthbert, Carnegie Steel Co., W. H. White, Pittsburgh Rolls Corp., and George H. Zoerb, Sharpsburg Foundry Co.

Following the business meeting, W. T. Sheffield, foundry manager, Hershey Machine & Foundry Co., Manheim, Pa., addressed the group on "Internal Shrinkage of Cast Iron." Mr. Sheffield spoke extemporaneously on some of the problems encountered by many gray iron foundrymen. Aside from discussing the origin of numerous troubles, he devoted considerable attention to control of the difficulties.

The June meeting of the group will be the annual picnic at one of the country clubs in the Pittsburgh district.

Purchases Plant

Walsh Refractories Corp., 4428 North First street, St. Louis, has purchased the plant and clay properties of the North Missouri Refractories Co., formerly the Missouri Fire Brick Co., at Vandalia, Mo. N. S. Chouteau Walsh is president of the company.

A Correction

Wheel center tests outlined by J. C. Smith, Bonney-Floyd Co., Columbus, reported on page 40 of THE FOUNDRY for May, were in error. These tests were made with a 5-ton ball dropped from a distance of 20 feet. The heat treatment of wheel centers consisted of a quench from 1600 degrees Fahr., followed by a tempering operation at 1150-1200 degrees Fahr.

J. W. Snavely has been placed in charge of the Houston, Tex., sales office of the Chain Belt Co. which recently reopened at 3118 Harris boulevard. Mr. Snavely formerly was connected with the sales department at the home office in Milwaukee.

Type SB Core Blower

There are 14 Types of INTERNATIONAL MACHINES

designed especially for making CORES

Type R Core Turnover Machine

This machine has many new constructional and operating features. It is the latest addition to our extensive line of JOLT SQUEEZERS.

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(This machine can be built with a stationary base—if preferred.)

We build 61 Standard Types of machines for castings and many Special Types for work of unusual nature

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European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Casting Magnesium

Magnesium; Metallurgical and Foundry Practice (Le Magnesium; Metallurgie et Fonderie), by Paul Bastien. *Bulletin* de l'Association Technique de Fonderie, Paris, October, 1933.

The principal physical property of magnesium is its extreme lightness. Chemically it has a strong affinity for oxygen. It combines with nitrogen from a temperature of 780 degrees Cent., and it decomposes water at a temperature above 70 degrees, with liberation of hydrogen. These reactions must be taken account of in the metallurgy of magnesium. Industrial magnesium, 99.5 per cent pure, as cast in sand, has a tensile strength of about 15,000 pounds per square inch, with elongation of about 6 per cent.

Three principal alloys are available: (1) Magnesium and aluminum, containing from 4 to 8 per cent aluminum; (2) A ternary alloy of magnesium, aluminum and zinc, which is the basic composition of *electron;* (3) A ternary alloy of magnesium, aluminum and copper. These alloys, when cast in sand, have a tensile strength of about 25,000 pounds per square inch, with elongation from 5 to 8 per cent.

Magnesium is obtained by electrolysis of one of its salts in an iron vat which constitutes a cathode, while the anode is constituted generally by carbon. Magnesium prepared thus generally contains inclusions of chlorides, which have a detrimental effect on the alloys and which must, therefore, be eliminated.

Experiments have been conducted enabling the metal to be sublimated toward 600 degrees Cent. Volatilized magnesium is deposed on a condenser, and it must then be remelted under pressure in an atmosphere of argon. It is thus possible to obtain a metal which is chemically pure and giving 35,000 pounds per square inch tensile strength, with 18 per cent elongation when laminated.

Owing to the great affinity of magnesium for silica, the metal is melted in iron crucibles. Owing to the affinity of magnesium for oxygen and nitrogen, a flux must be used which protects the surface of the metal; such fluxes generally are composed of chlorides or fluorides of magnesium or similar metals. First, the flux is melted in the crucible, and the metal then is added gradually. In the case of the preparation of alloys, there is no difficulty in adding the alloying metal.

The alloy is refined by agitating the bath, when the impurities become enrobed in the flux and fall to the bottom of the vat. Precautions must be taken during pouring, owing to the tendency to oxidation, and also to avoid the flux being taken along with the metal. Oxidation and nitration can be avoided by pouring at a good temperature in an atmosphere made reducing by the presence of sulphur powder, which is thrown over the tap hole. It also is possible to pour the magnesium under its own skin of oxide, as is done with aluminum. To prevent the flux from being taken along with the metal, the flux is made viscous by the addition of sulphur and it is kept back by a rake.

The sand molds must be prepared specially to avoid humidity, and, therefore, the sand is mixed with sulphur, boric acid or ammonia fluoride. Owing to the low density of the metal, the air from the mold must be evacuated easily; therefore, sands with a high degree of permeability should be used. Owing to the low calorific capacity of the metal, the runners should be as short as possible. Magnesium can be cast in metal molds or die-cast, but there are considerable difficulties, which, however, have been overcome in Great Britain where the die-casting process is used for aviation parts. It also is possible to use pressure die-casting for magnesium, but little information is available on that point.

Castability of magnesium is not high, but addition of aluminum or copper increases the castability. It has been shown that after remelting magnesium alloys several times, the castability first rises with each operation and then decreases. It has been found that the metal cools all the quicker and its castability is smaller as the contents of volatile matter in the sand is greater.

Total contraction of magnesium is considerable, being of the order of 19/1000. Owing to this characteristic and also to its low castability, it is difficult to obtain magnesium castings having a complicated shape. It has been found that contraction in die-casting is less than in sand molds, and that the addition of aluminum reduces the contraction of magnesium.

Die Casting Machines

Pressure Die-Casting. (Le Moulage Sous Pression, by F. Nillsen. *Bulletin* de l'Association Technique de Fonderie, Paris, March, 1934.

Dealing first with die-casting machines in which the metal is pushed by a piston, it is stated that such machines have their limitations as regards the sizes of the castings to be obtained when these machines are hand-operated. For tin alloys, a hand-operated machine will give good results but with zinc and other alloys there is a danger of the piston becoming seized in the cylinder. Great care should be taken in the design of the crucible and of the nozzle used in connection with such machines.

Nearly all compressed air machines are provided with an injector recipient termed *goose-neck.* Owing to unfavorable effects of repeated movements of the goose-neck on the qualities of the metal, a type of machine in which the air would act directly on the metal would be preferable.

Recommendations are made as regards nozzles, which should be as short as possible, and for which pearlitic iron is the material that seems to give the greatest resistance to wear. Examples are given of the best methods of injecting the liquid metal and of attacking the mold. A discussion follows on the contraction of alloys used, and recommendations are made as regards the best methods of ejecting the castings from the machines.

TABOR

TRADE 1884 MARK

CANTILEVER JAR SQUEEZER

Open on three sides for convenient handling of flasks

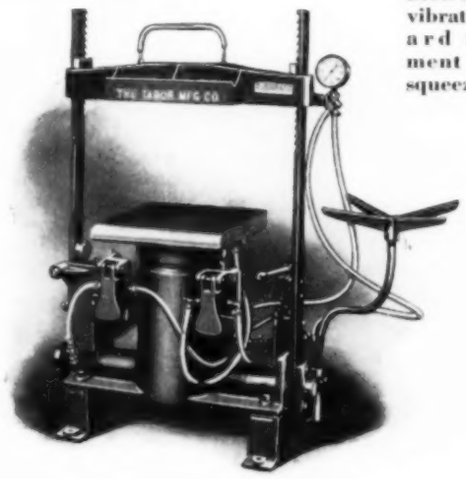
This squeezer has been built for "snap" work to round out the otherwise complete TABOR Power Squeezer Line. It is *sand-proof.* The cantilever yoke feature of this new 10″ squeezer provides ease of operation and a rigidity that ensures accurate molds. The TABOR yoke *will remain rigid,* and the ramming block is readily adjustable. Made either plain squeeze or jar squeeze, stationary and portable (22″ wheel spread). This is the ideal machine for rapid, low cost, accurate production.

SPECIFICATIONS

Table	18″ x 18″
Diam. Squeeze Cylinder . .	10″
Diam. Jar Cylinder	4″
Width over wheels	22″
Space needed behind machine to accommodate swing yoke .	26″

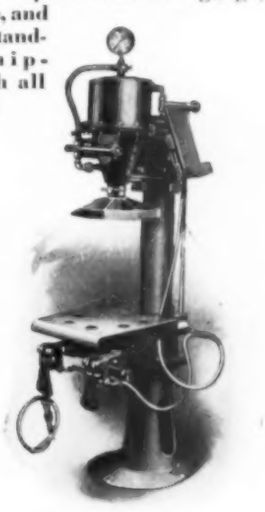
Yoke Jar Squeezer

This 10″ Jar Squeezer stands out for uniformity of squeeze and ease of operation. The large diameter squeezing cylinder exerts a steady squeezing pressure to pack sand to the correct density throughout the mold. Unusually long and carefully fitted pistons prevent wobbling and assure a long life of accurate molds. Made either plain squeeze or jar squeeze, in 10″, 13″ and 16″ cylinder; also furnished portable.



Post Jar Squeezer

The TABOR 10″ Post Squeezer was built to fill a general demand for a low priced, light weight, fast, machine with overhead squeeze cylinder. Made in power squeeze and jar squeeze; and with two types of portable bases: one for moving parallel to the sand heap and the other with 22″ clearance under the frame with a wheel spread of 72″ for straddling the sand. Table 16″ wide x 19″ deep. Adjusted easily and quickly for varying flask depths. Pressure gauge, blow valve, and vibrator standard equipment with all squeezers.



Dust Arrestor—, Core Room—, Tumbling Barrel and Brass Founders' equipment; Sand Blast Machinery, Cupolas and accessories, Ladles, tools, etc. Repair and replacement parts carried in stock for the "Paxson Line." Special machines designed and built. Inquiries welcomed.

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50TH ANNIVERSARY YEAR

Obituary

SAMUEL D. SLEETH, 81, for many years superintendent of foundries of the Westinghouse Air Brake Co., Wilmerding, Pa., died at Cambridge Springs, Pa., May 9. Mr. Sleeth was born in Pittsburgh in 1852, and when 13 years old secured a job as core boy at the foundry of Lewis, Oliver & Phillips. He worked in two or three other foundries in Pittsburgh previous to 1870, when he went to work for his father, James Sleeth who was foreman of the Westinghouse Air Brake Co. In 1880 the business of the Westinghouse company was moved to a larger plant in Allegheny and in 1887 Mr. Sleeth was appointed assistant foreman. Following the death of his father, in 1890, he was appointed foreman, and the same year the company built a large plant at Wilmerding. About 1904 he was appointed superintendent of foundries and was given charge of the pattern shop and the brass foundry in addition to the combined iron foundries. During the war the Westinghouse company took over the plant of the Union Switch & Signal Co., Swissvale, Pa., and Mr. Sleeth was appointed superintendent of foundries in Wilmerding and Swissvale. Eleven years ago he retired from active work but continued as consulting foundry engineer for the company.

Samuel D. Sleeth

Mr. Sleeth was the oldest living ex-president of the Pittsburgh Foundrymen's association, having served as head of that group in 1900-1901. He attended the organization meeting of the American Foundrymen's asociation in Philadelphia in 1896, and served for one year as vice president of that association.

♦ ♦ ♦

Edwin Lewis Crosby, 53, president, director and founder of the Detroit Electric Furnace Co., Detroit, died in Ludlow, Mass., Saturday, May 5, as a result of injuries received in an automobile accident. Mrs. Crosby, who also was injured, has recovered.

Mr. Crosby was born in Plymouth, Mich., and after graduating from the Plymouth high school went to work for the Semet Solvay Co., Detroit. Later he completed a course in electrical engineering and for several years was in charge of electrical operations in a Semet Solvay plant. In 1905 he entered the employ of the Detroit Edison Co., Detroit. For 13 years he was chief power salesman of that company.

Edwin L. Crosby

Leaving the Detroit Edison Co. in May, 1908, Mr. Crosby organized the Detroit Electric Furnace Co. of which he became vice president and general manager. In 1920 he was elected to the presidency of the company. Mr. Crosby was an active member of the American Foundrymen's association and the American Electro Chemical society, and was a frequent contributor to foundry and electrical publications.

♦ ♦ ♦

Shelby E. Kennedy, 85, for many years employed as a patternmaker by the Great Western Mfg. Co., Leavenworth, Kans., died recently.

♦ ♦ ♦

James R. Smith, 51, for more than 20 years identified with the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., and for more than 10 years special representative for the company at Cleveland, died in Pittsburgh, May 20.

♦ ♦ ♦

Ernest H. Cornelius, president, Oklahoma Steel Castings Co., Tulsa, Okla., died in Cleveland, May 8. Mr. Cornelius was born in Hastings, Nebr., Oct. 28, 1890. He received his education at Northwestern university and the University of Nebraska and then became a salesman for a small steel company in the Texas territory. A short time later he became connected with the Kansas City Light & Power Co., and afterward in turn with the Metropolitan Street Railway Co. and the Kansas City Southern Railroad Co. In 1916 he went to Tulsa, where he became contracting engineer with the Oklahoma Structural Steel Co. A year later he started a structural steel business of his own. In 1920 Mr. Cornelius organized the Oklahoma Steel Castings Co. and since that time devoted the greater part of his efforts to the building up of that business. Mr. Cornelius was active in the affairs of the Steel Founders' Society of America and served as vice president and chairman of the Mid-Continent division of that group. In 1931 he served as president of the Associated Industries of Oklahoma and during his residence in Tulsa was actively interested in numerous civic enterprises.

Ernest H. Cornelius

♦ ♦ ♦

John Carr Woodison, 53, president, E. J. Woodison Co., Detroit, died May 11 following a brief illness. Mr. Woodison was born in Windsor, Ontario and had been affiliated with the E. J. Woodison Co.

(Concluded on page 65)

ADVERTISING PAGES REMOVED

(*Concluded from page 62*)

since 1912, first as secretary, later as vice president and then president upon the death of his brother, E. J. Woodison. Mr. Woodison was also president of the E. J. Woodison Co. Ltd., Toronto, Ontario; vice president of the Canadian Foundry Supplies & Equipment Limited, Montreal; vice president, M. A. Bell Co., St. Louis; and vice president of the Wolverine Buff Co., Detroit.

• • •

Harry G. Francis, 70, president, Charles E. Francis Co., Rushville, Ind., and Cincinnati, died recently after returning from a trip to Florida. He was also president of the Dill Foundry Co.

• • •

Oliver H. P. Champlin, 69, secretary, Strong Steel Foundry Co., Buffalo, died May 12. Mr. Champlin was identified with the steel foundry industry since 1907, when he founded the Strong company. He was active in the business as president and treasurer until 1928.

Book Review

Casting of Brass Ingots, by R. Genders and G. L. Bailey, cloth, 191 pages, 6 x 10 inches, published by the British Non-Ferrous Metals Research association, London, and supplied by THE FOUNDRY, Cleveland, and in Europe by the Penton Publishing Co. Ltd., London.

Interesting and valuable data in summarized form of results of the research on brass ingot castings, which has been carried out by the British Non-Ferrous Metals Research association over a period of years, are presented in this volume, the third in a series of research monographs published by the association. The first was devoted to "Tin Solders" and the second to "Metallurgical Analysis by the Spectrograph."

The researches on brass ingots were directed primarily toward obtaining a full understanding of the factors involved in the casting process, and the manner in which these factors influenced the soundness and surface quality of the cast ingots. The book opens with a historical chapter and a description of commercial practice, followed by a detailed account of the characteristics of brass ingots and rolled strips, and of the causes of the main types of defects in them. The main portion of the book is devoted to a detailed discussion of various factors influencing the quality of the ingots, their chief points dealt with being the formation of the ingots from the liquid metal, the effect of casting temperature, speed of pouring and feeding, dimensions of the ingots, effect of mold coating and materials for the construction of ingot molds. Modified and improved casting methods are suggested and special casting developments such as the Durville process are discussed.

The authors believe that the ultimate value of the book and of the work which underlies it is not confined to the practice of brass casting, since the principles which have been established are in many cases equally applicable to the casting of other metals. The book should be of considerable value to those interested directly or indirectly in nonferrous and metallurgical practice.

A. S. T. M. Committee Studies Refractories

The committee on refractories of the American Society for Testing Materials, as a result of recent work, will propose new specifications for approval at A. S. T. M. tentative standards covering widely used refractory materials. The committee will propose the adoption as standard of the tentative method of test for particle size of ground refractory materials. A number of revisions previously submitted, in the method of test for softening point of fire-clay will be proposed for adoption as standard. The tentative method of control test for resistance of fire-clay brick to thermal spalling action, often termed the "water dip spalling test" is to be withdrawn.

A number of changes are to be proposed as tentative for inclusion in the methods of testing high-temperature heat insulation. Several studies and research projects are being carried on by the committee. The investigation of methods for determining thermal conductivity of refractory material is to be continued; a panel spalling test is being studied; and work is contemplated on load tests of heavy duty fire brick at temperatures higher than those now specified in the standard test.

R. A. Heindle, chief, refractories section, bureau of standards, Washington, is chairman, and C. E. Bales, vice-president, Ironton Fire Brick Co., Ironton, O., is secretary of the committee.

Make Examinations

Lucius Pitkin Inc., 47 Fulton street, New York, recently announced the inauguration of a special service in making spectographic and analytical examinations of metal, either raw material, ingots, run down scrap or castings. The company also will supply x-ray service.

Society To Meet in Atlantic City June 25-29

The thirty-seventh annual meeting of the American Society for Testing Materials will be held at Chalfonte-Haddon hall, Atlantic City, N. J., June 25-29. In the metals field the technical program will feature creep tests and properties, effect of size of test specimens, corrosion of steel under water, design and protection from corrosion of pipe line, and impact strength of die castings.

The nominating committee recently made the following nominations for officers: President, W. H. Bassett, metallurgical manager, American Brass Co., Waterbury, Conn.; vice president, H. S. Vassar, laboratory engineer, Public Service Electric & Gas Co., Irvington, N. J.; members of the executive committee, H. A. Anderson, metallurgical engineer, Western Electric Co., Chicago; H. J. Ball, professor of textile engineering, Lowell Textile institute, Lowell, Mass.; W. M. Barr, assistant to executive vice president, Union Pacific railroad, Omaha, Nebr.; L. S. Marsh, manager, department of inspection and metallurgy, Inland Steel Co., Chicago; and J. B. Rather, in charge, General Laboratories, Socony-Vacuum Corp., New York.

C. E. Adams Is Made Division Administrator

Appointment of Charles Edward Adams, president of the Air Reduction Co., New York, as Division Administrator in Division I to succeed Kenneth M. Simpson, whose resignation has been accepted, was announced June 1 by National Recovery Administrator Hugh S. Johnson.

Mr. Simpson will continue as an Administration member of the Iron and Steel Code Authority and following his return from an European vacation will be available as an adviser, according to the Administrator.

Mr. Adams who is also chairman of the United States Industrial Alcohol Corp. and an officer or director in several other firms, has recently been a deputy administrator in charge of finance and insurance codes.

In 1932 the federal, state and local governments disbursed in the form of salaries, wages and interest, $6.8 billion, or about $900 million more than the total income of $5.9 billion produced by all manufacturing industry of the country, according to an analysis of figures of the changes in production and distribution of national income since 1929, recently issued by the National Industrial Conference board.

New Equipment

For Foundries

Machine Screens and Aerates Molding Sands

Beardsley & Piper Co., 2541 North Keeler avenue, Chicago, has introduced a new unit for screening, blending, aerating and piling sand. In operation the sand is shoveled on to a corrugated screen which breaks up the lumps and screens out and discharges refuse, gaggers, cores and other sand contamination. The sand dropping through the screen is discharged from the unit into a fluffy pile.

The rotor, the one moving part of the machine, revolves on roller bearings on a stationary shaft and is driven by cut gears mounted on the rotor. An eccentric shaft, also mounted in roller bearings, is located above the rotor and is attached to the screen to provide the screening motion. It is claimed the sand is doubly aerated. Primary aeration is secured as the sand is screened and secondary aeration is provided when the sand is discharged from the machine by the rotor.

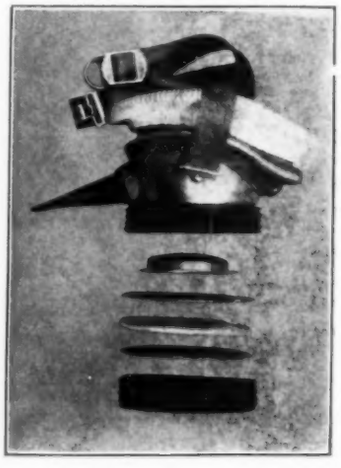
The unit, which is shown in the accompanying illustration, is provided with a 1½ horsepower, fully enclosed ball bearing motor. The hopper is 25 x 40 inches and the screen is of the corrugated type with 9 square feet of surface. The screen is so designed that it may be removed quickly. The capacity of the machine is from 500 to 1000 pounds per minute, depending on the mesh of the screen. The unit weighs approximately 325 pounds.

An eccentric shaft mounted above the rotor provides the motion for the screen

Respirator Gives Protection Against Dust

Pulmosan Safety Equipment Co., 176 Johnson street, Brooklyn, N. Y., recently has introduced a new line of respirators, consisting of six types. These respirators have been designed to provide protection against dust in all operations in iron, nonferrous and malleable foundries. The units have a filter 3 inches in diameter, a coarse screen and a filter cap arranged to keep the filter away from the intake orifice. A special noninflating rubber face cushion is employed to provide a proper fit and give comfort to the wearer. Screens are bound with aluminum for strength and safety in changing and replacing filters. Headbands are attached to a specially designed swivel point, allowing free movement without danger of the respirator leaving the face of the workman.

One type has a positive exhaust valve as is used on gas masks. A second has no exhaust port making it necessary to breathe in and out through the filter. A third has the exhaust valve and is fitted with an intake valve to prevent retention of exhaled air and the filter becoming damp with moisture. The intake valve in that model is automatic. A view of the parts in the third type of respirator is shown in the accompanying illustration.



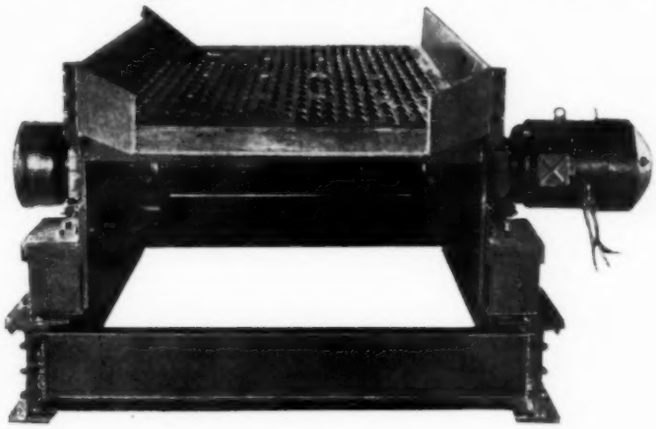
Parts of respirator having exhaust and intake valve

Stoker Unit Has New Features of Design

Link-Belt Co., 910 South Michigan avenue, Chicago, recently has developed a new domestic unit in its line of underfeed screw type stokers. The design includes several new features, especially in the mounting, transmission and coal burning end. The hopper is extra large, having a coal capacity of 500 pounds. The height of the hopper is 26 inches above the floor level.

This unit may be applied to foundry core ovens, where the requirements are within the range of the stoker capacity.

Simplicity Shake-Out Screens



are
Producing Cleaner Castings
with
Resultant Sand Saving
at
Lower Operating Costs
because
Maintenance Expense is Reduced to a Minimum

Continuous service under severe conditions in Production Foundries with these results are bringing Repeat Orders. Of equal value in the reduction of foundry costs are the Simplicity Gyrating Screens for cleaning moulding sand through 1/8", and the Simplicity Conveyor for Hot Castings. Each Simplicity Unit is designed and built to meet conditions in your own plant; with satisfactory operation guaranteed.

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"Certified" Steel Abrasives are without a peer for hardness, cutting action, wearing quality, and safety. They do not "break up" under impact—therefore give off no Dust from themselves. Long life—may be used over and over again. The safe abrasives for your operator's health, and THE MOST PROFITABLE FOR YOU!

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"Certified" Steel Abrasives are recommended by leading Blast Cleaning Manufacturers

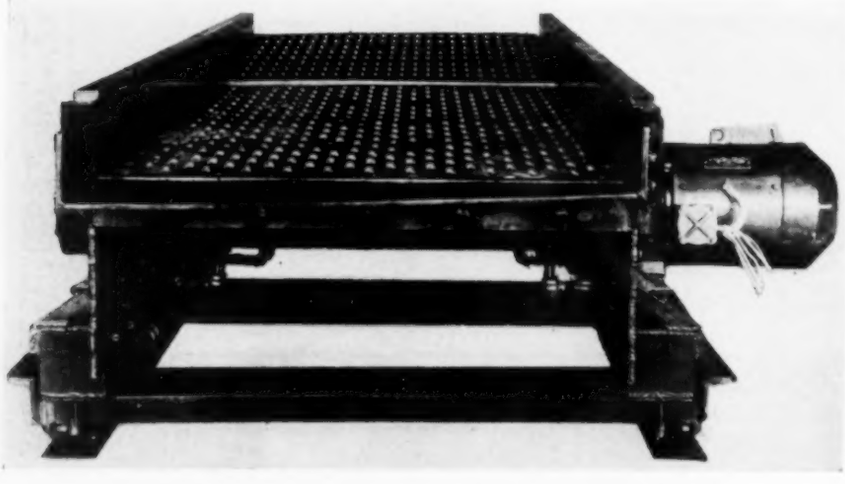
Blowers Have Variable Speed Drive

Roots-Connersville Blower Corp., Connersville, Ind., now is supplying some of its line of blowers, vacuum pumps, and gas pumps connected through a variable speed drive to a constant speed motor. In the rotary positive type machine, the lower consumption varies in almost direct proportion to the volume and the pressure being delivered. Thus the use of a variable speed arrangement permits this economy to be carried through the entire operating range.

Vibrating Screen Has Counter Balanced Shaft

Simplicity Engineering Co., Durand, Mich., recently has introduced a shakeout screen and a gyrating screen for foundry use. Each unit is constructed along identical lines, operating at a speed of 1200 revolutions per minute, with the vibration produced by the counter balanced eccentric gyrating shaft. Due to the counter balancing of the units, it is pointed out that all of the positive vibrations produced by the action of the eccentric shaft are utilized in the deck of the screen with none being dissipated throughout the supporting structure. In this way the heaviest type of shake-out screen operates without vibration in its I-beams or in the structure which carries the screen. It is claimed this feature particularly is valuable in sand screens which usually must be mounted high over bins.

The counter balance is machined directly on the shaft, and the shaft is enclosed in a specially protected tube so that there are no outside moving parts in the gyrating assembly. Antifriction bearings are used and these are protected by specially designed labyrinth seals. In the shake-out type screen the eccentric bearing housings are water cooled. The screens are mounted on resilient rubber corner supports to aid in operation without external vibration. The rubber supports also are protected from the heat.



Screens are mounted on resilient rubber corner supports

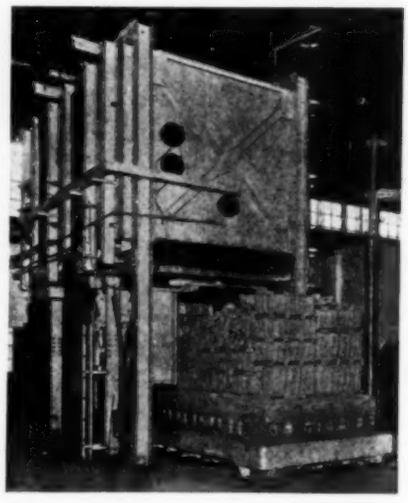
Annealing Furnace Operates on Short Cycle

A short cycle malleabilizing furnace designed to reduce the total time for heat treatment to 72 hours or less, is being marketed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Elimination of decarburized surfaces, hard skin or hard spots on the surface, picture frame structures, burned or scaled castings, is done by malleablizing based on the chemical analysis of the cast iron in an electrically heated furnace having automatically controlled atmosphere.

The heating up of the charge is done at night, during off-peak load, with only radiation losses supplied during the day. Furnaces range from ½ to 25 tons, with maximum night time electrical loads of 40 to 600 kilowatts, and corresponding electrical capacities of 13 to 75 kilowatts during the daytime. Energy consumption for the 72 hour malleablizing cycle per gross ton of charge (castings and boxes when required) is as follows: 25 ton furnace, 375 kilowatt hours per gross ton: 12 ton furnace, 450; 7½ ton furnace, 500; 1 ton furnace, 625; ½ ton furnace, 775.

Since a definite time-temperature cycle is laid out, depending on the chemical analysis of the iron, every casting must be of the highest quality as to tensile strength, elongation, and machinability, for the particular analysis. Any up-to-date plant having average melting supervision and analysis control may employ successfully this 72 hour annealing cycle. Twenty-six hour cycles have been obtained by companies having these furnaces in operation on castings ½-inch thick and where the analysis is carefully controlled.

Packing materials and heavy cast iron pots are not required. Some castings may have to be annealed in boxes, but without the use of packing material. These include castings that will not withstand much weight without danger of warpage, or small castings that cannot be stacked up on the car in sufficient quantity to produce a full charge.



The electrically heated furnace has an automatically controlled atmosphere

Refractory Cement Has Chrome Ore Base

Botfield Refractories Co., Swanson and Clymer streets, Philadelphia, recently has introduced a new chrome base refractory cement which has a number of uses including the making of dipped or troweled joints, laying up fire brick, and patching work on furnace hearths and monolithic refractory construction.

The base of the cement is a South African chrome ore with a high chromic oxide content and a low silica content. Under tests the cement has shown a pyrometic cone equivalent of 38, corresponding to a temperature of 3335 degrees Fahr. The cement is marketed under the name Adachrome.

H. S. Colby, formerly president, Air Preheater Corp., has been made general sales manager of the Combustion Engineering Co., New York. Mr. Colby received his technical education at Cooper Union and Columbia university and for the past 20 years has been engaged in the design, production and sale of steam generating equipment and air preheaters.

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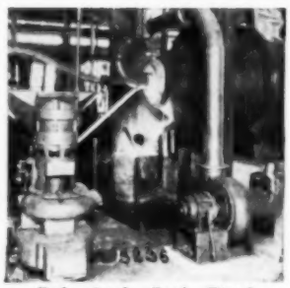


Pulverized Coal Fired Rotary Melting Furnace for high test iron.

The sure way to foundry profits under the new codes is through lower costs. Lower costs require modern equipment and methods. Let us show you what we have done for others.

Write for our 48-page book, "Modern Melting Methods".

WHITING CORPORATION
15607 Lathrop Ave. Harvey, Ill.

Cranes, Cupolas, Cupola Chargers, Ladles, Tumblers, Dust Filters, Air Furnaces, Steel Converters, Rotary Furnaces, Quick-Anneal Ovens, etc.

WHITING

"Fifty Years Service to Foundries"

Ask for these FREE hardened and working samples

SMOOTH-ON No.4
in new and greatly
IMPROVED COMPOSITIONS

Smooth-On No. 4AA. For light gray castings and machined surfaces. Has high metallic lustre and takes a fine machine finish.

Smooth-On No. 4A. For medium gray castings. A fine-grained cement that has a good metallic lustre.

Smooth-On No. 4B. For dark gray castings. A cement of coarser grain and darker shade.

GET the free samples. Hold the *hardened* ones on the card aside of your own product and you will see that the *wider color and lustre range* offers desirable selection for any casting. If your filled surfaces must be machined note the fine finish on the milled portion of the No. 4AA sample.

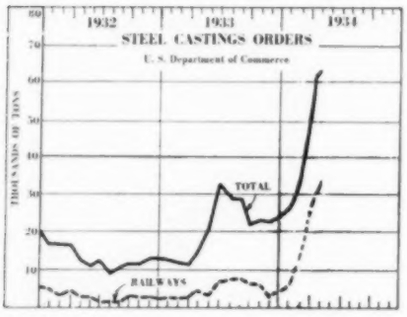
Then try the *working* samples, and note the big improvement over the results you have been getting. The standard shades may be modified in the application.

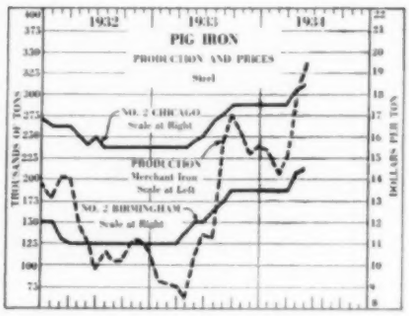
Do yourself and us the justice of making a critical test and you will find your filling problems *well solved.*

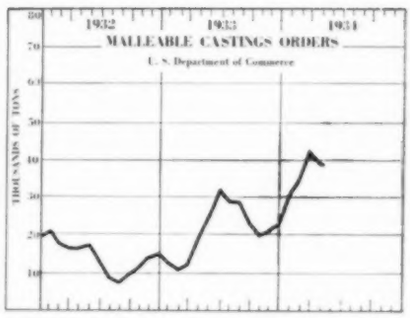
Mail the coupon for samples and prices. Smooth-On Nos. 4AA, 4A and 4B are packed in 1-lb. and 5-lb. cans, 25-lb. pails and 100-lb. kegs.

Smooth-On Mfg. Co., Dept. 17,
570 Communipaw Ave., Jersey City, N. J.
Please send working samples of
Smooth-On ☐ No. 4AA Smooth-On ☐ No. 4A Smooth-On ☐ No. 4B
☐ Hardened samples of all three
Name.....
Address.....
.....
6-34

SMOOTH-ON







Foundry Activities

Reflect Industrial Trends

SIBLEY MACHINE CO., South Bend, Ind., will build a 1-story foundry addition, 100 x 145 feet, to cost in excess of $50,000. Frank D. Chase Inc., 807 North Michigan avenue, Chicago, is architect and engineer. General contract has been let to Ralph Sollitt & Sons, South Bend.

* * *

Dayton Casting Co., Dayton, O., recently was damaged by fire to the extent of $18,000.

* * *

American Radiator Co. recently resumed operations at its Bayonne, N. J. plant.

* * *

Eagle Brass Foundry, Seattle, is constructing an addition 16 x 46 feet at its plant at 21 Spokane street.

* * *

Pipe foundry at the Minnequa plant of the Colorado Fuel & Iron Co., Pueblo, Colo., recently was reopened.

* * *

Slack-Horner Brass Mfg. Co., Denver, recently was damaged by fire to the extent of over $3000.

* * *

Canadian Car & Foundry Co., Toronto, Ont., recently was reported planning to resume operations at its Amherst, N. S. plant.

* * *

General Foundry & Mfg. Co., Flint, Mich., has been incorporated by the General Foundry & Machine Co. to manufacture automotive parts.

* * *

Lowe Foundry Co., 515 West Main street, Ottumwa, Iowa., has changed its name to the Ottumwa Foundry Co. C. B. Leedom is manager, and L. L. Davolt is secretary and foreman.

* * *

Hicks, Hirst & Co. Inc., Taunton, Mass., has been formed by William Hirst, 272 Centre street, Bridgewater, Mass., to operate a jobbing gray iron foundry.

* * *

France Foundry & Machine Co., 1215 West Bancroft street, Toledo, O., has purchased the assets of the bankrupt Alloy Foundry & Machine Co., 401 Hamilton street.

* * *

Reliable Pattern & Castings Co., 2822 Spring Grove avenue, Cincinnati, plans to build a 1-story addition 62 x 120 feet at a cost exceeding $35,000, including equipment.

* * *

Harry A. Robinson, Morris building, Philadelphia, has purchased 12 buildings formerly used by the Cramp Brass & Iron Foundries Co. with about 100,000 square feet of floor space.

* * *

Great Falls Iron Works, Great Falls, Mont., has been incorporated with $50,000 capital to operate a foundry, by T. J. Sullivan, Butte, Mont., R. H. Barclay and A. A. Pinski, both of Great Falls, Mont.

* * *

International Harvester Co., 122 East Forty-second street, New York, has leased a foundry at 556 West Twenty-sixth street, New York, owned by John Williams Inc., and will convert it into a factory branch.

* * *

Erie Bronze & Aluminum Foundry Inc., 1979 McComb street, Detroit, has been formed to manufacture brass, iron and aluminum castings, by John A. Frederickson, 5947 Fifteenth street, Detroit.

* * *

Anderson Stove Co., Anderson, Ind., recently rented a factory building at the intersection of Jefferson street and the Big Four railroad, formerly occupied by the Lavelle foundry. The building will be used as an auxiliary foundry during the busy season of the year.

* * *

Milwaukee Malleable & Grey Iron works, Milwaukee, reports business so improved that it has been obliged to return to service the formerly idle half of the malleable shop. Alterations have been made in the gray iron department to accommodate a new cupola and auxiliary equipment including sandblast machinery.

* * *

Production of steel castings in the Philadelphia Federal Reserve district increased during April for the fifth

(*Concluded on page 73*)

RAW MATERIAL PRICES
June 5, 1934

Iron		
No. 2 foundry, Valley		$18.50
No. 2 Southern, Birmingham		14.50
No. 2 foundry, Chicago		18.50
No. 2 foundry, Buffalo		18.50
Basic, Buffalo		17.50
Basic, Valley		18.00
Malleable, Chicago		18.50
Malleable, Buffalo		19.00
Charcoal iron, furnace		21.00
Coke		
Connellsville beehive premium		$5.10
Wise county beehive coke	3.50 to	4.25
Detroit by-product coke		8.50
Scrap		
Heavy melting steel, Valley	$11.00 to	$11.50
Heavy melting steel, Pitts	11.75 to	12.25
Heavy melting steel, Chicago	9.50 to	10.00
Stove plate, Buffalo	9.00 to	9.50
Stove plate, Chicago	7.00 to	7.50
No. 1 cast, New York	7.00 to	7.50
No. 1 cast, Chicago	8.50 to	9.00
No. 1 cast, Pittsburgh	11.50 to	12.00
No. 1 cast, Philadelphia		12.00
No. 1 cast, Birmingham	10.00 to	11.00
Car wheels, iron, Pittsburgh	12.50 to	13.00
Car wheels, iron, Chicago	10.00 to	10.50
Railroad malleable, Chicago	11.00 to	11.50
Malleable, Buffalo	12.50 to	13.00
Nonferrous Metals		
		Cents per pound
Casting copper, refinery		8.25
Straits tin		51.40
Aluminum, No. 12, producers	18.00 to	22.00
Aluminum, No. 12 (Standard)		15.00
Lead, New York		4.00
Antimony, New York		8.25
Nickel, electro		35.00
Zinc, East St. Louis, Ill.		4.25

ADVERTISING PAGES REMOVED

(*Concluded from page 70*)

consecutive month, reaching the highest output of any month since April 1931, according to reports received by the Industrial Research department of the University of Pennsylvania. The output of malleable iron castings also increased. The production of gray iron castings in April was less than in any previous month for 1934.

* * *

Fahralloy Co., 146th street, Harvey, Ill., has been incorporated by Reuben A. Borsch, Thomas I. Underwood and Margaret Grorer.

* * *

Majestic Pattern Works Inc., Detroit, has been formed to produce patterns, by Gerhardt E. Bauer, 4457 Kensington road.

* * *

Negotiations have been under way between the Illinois Foundry Co., Springfield, Ill., M. W. Baker, general manager, and Farm Tools Inc., Galva, Ill., for the rental of part of foundry and machine shop of the Hayes Pump & Planter Co., division of Farm Tools Inc., for production and machining of castings. It is reported the Galva foundry will be in operation soon.

* * *

Crucible-Electric Steel Casting Co., Milwaukee, has been formed by W. W. Lange, John H. Schlintz and M. E. Borkenhagen.

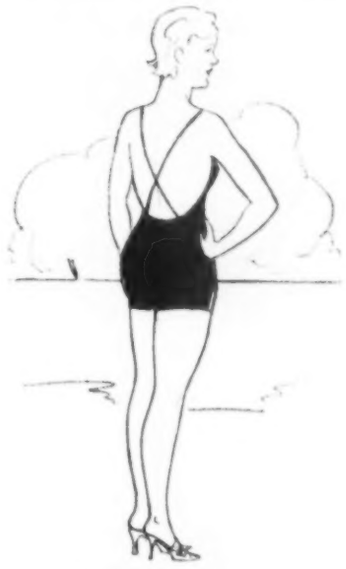
* * *

Draper Corp., Hopedale, Mass., textile machinery manufacturer, will build a three-story foundry addition 140 x 160 feet, to cost over $400,000, on plans by F. P. Sheldon & Sons, Providence, R. I.

* * *

Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich., has opened its No. 1 plant on Sanford street, closed since July, 1930. Repairs and improvements to plant and machinery have been made.

Faked Foundry Facts



A Filling Frame

New Trade Publications

MAGNESIUM—Information of interest to engineers and designers on the use of magnesium alloys is contained in a data book recently published by the Dow Chemical Co., Midland, Mich. Information includes uses, forms in which the material is available, design, shop practice, color finishes, property tables, structural shapes, etc.

SPOT WELDERS—A leaflet published by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., illustrates and describes a new line of spot and projection welding equipment for manual or motor operation.

ARC WELDING—Hobart Bros. Co., Troy, O., recently has published a booklet which illustrates and describes briefly a number of modern applications of electric arc welding in industry.

AIR CONDITIONING—Importance of air conditioning in modern business is discussed in a recent booklet published by the General Electric Co., Schenectady, N. Y. Several types of air conditioning equipment are illustrated.

PUMPS—Pennsylvania Pump & Compressor Co., Easton, Pa., has published bulletin No. 223 on its combination pump and blower unit. A description of the various parts of the unit together with head capacity tables are featured.

TRAMRAILS — Cleveland Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has published a bulletin in which is presented a large drawing showing various types of tramrail equipment applied to foundry operations.

GRINDING EQUIPMENT—Patterson Foundry & Machine Co., East Liverpool, O., has published a bulletin illustrating the use of its grinding equipment in various industries including ceramic, paint, chemical, minerals and food products.

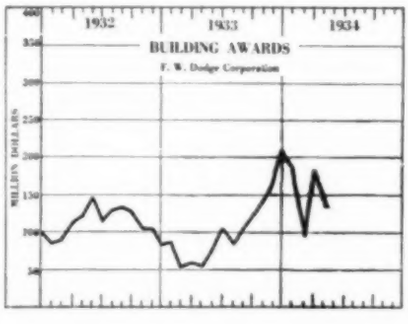
PUMPS—Ingersoll-Rand Co., Phillipsburg, N. J., in a recent bulletin describes its line of multistage centrifugal pumps. An interesting feature of this pump is the hydraulic balance obtained by placing an equal number of impellers back to back. Construction and application are discussed in the publication.

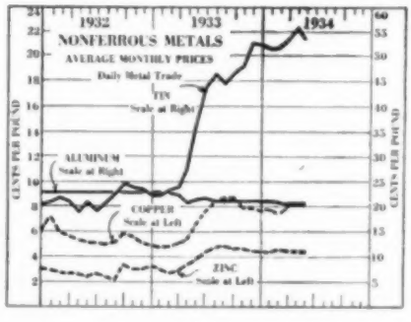
ENGINEERING — Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has published a 36-page booklet devoted to "Engineering Achievements of 1933." Items of interest to the foundry field include materials handling, welding, testing, air conditioning, etc.

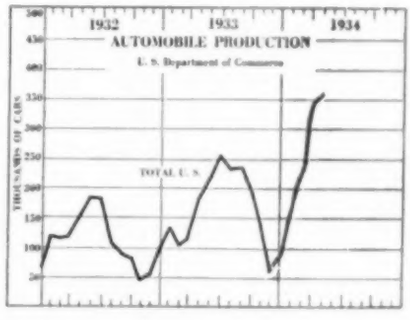
COMPRESSORS—Single horizontal, single stage, air compressors, either steam or motor driven, are described and illustrated in a recent bulletin of the Worthington Pump & Machinery Corp., Harrison, N. J. Construction of the various parts of the compressor is discussed and information is presented on the sizes available.

STEEL CASTINGS—A recent publication of the Sivyer Steel Casting Co., Milwaukee, commemorates the 25th anniversary of the foundry and illustrates the methods and equipment employed when the foundry was organized in 1919 as compared with the present methods of manufacturing plain and alloy steel castings.

CAPACITORS—The General Electric Co., Schenectady, N. Y., has published a booklet describing its line of capacitors for power-factor improvement. The publication describes and illustrates the type of equipment available, discusses the application of capacitors and develops the advantages secured with the use of that equipment.







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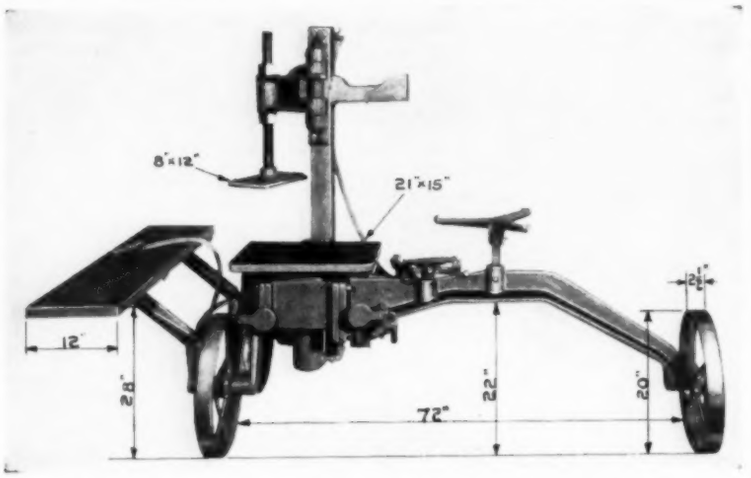

1 PROFITABLE INVESTMENT, low initial cost, increased production, more uniform castings.

2 SCIENTIFIC OPERATION, straddles the sand heap, knee valve jolt, poppet valve squeeze, pressure and jolt control valves regulate density of molds.

3 SIMPLE RIGID CONSTRUCTION. Anyone can dismantle or assemble complete machine in very little time.

4 DEPENDABLE CONSULTATION. More than twenty years of experience stands back of every J&J machine. Trained engineers are at your service.

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Highest Grade Lumber
Very Accurate Dimensions
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